W. B. No. 557

U. S. DEPARTMENT OF AGRICULTURE

WEATHER BUREAU

CHARLES F. MARVIN, Chief

MONTHLY WEATHER REVIEW

VOLUME 43, No. 6

JUNE, 1915

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

MONTHLY WEATHER REVIEW

CLEVELAND ABBE, Editor.

VOL. 43, No. 6.
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JUNE, 1915.

CLOSED AUG. 3, 1915
ISSUED AUG. 31, 1915

INTRODUCTION.

As explained in this Introduction during 1914, the MONTHLY WEATHER REVIEW now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

SUPPLEMENTS to the MONTHLY WEATHER REVIEW will be published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies.

Since December, 1914, the material for the MONTHLY WEATHER REVIEW has been prepared and classified in accordance with the following sections:

SECTION 1.—*Aerology*.—Data and discussions relative to the free atmosphere.

SECTION 2.—*General meteorology*.—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

SECTION 3.—*Forecasts and general conditions of the atmosphere.*

SECTION 4.—*Rivers and floods.*

SECTION 5.—*Seismology*.—Results of observations by Weather Bureau observers and others as reported to the Washington office. Occasional original papers by prominent students of seismological phenomena.

SECTION 6.—*Bibliography*.—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

SECTION 7.—*Weather of the month*.—Summary of local weather conditions; climatological data from regular Weather Bureau stations; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto.

In general, appropriate officials prepare the seven sections above enumerated; but all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.

The voluminous tables of data and text, relative to local climatological conditions that during recent years were prepared by the 12 respective "district editors," are omitted from the MONTHLY WEATHER REVIEW, but collected and published by States at selected section centers.

The data needed in Section 7 can only be collected and prepared several weeks after the close of the month whose name appears on the title page; hence, the REVIEW as a whole can only issue from the press within about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belen College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

SECTION 1.—AEROLOGY.

SOLAR AND SKY RADIATION MEASURED AT WASHINGTON, D. C., DURING JUNE, 1915.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., July 31, 1915.]

In Table 1 are summarized the measurements of the intensity of direct solar radiation made by the Weather Bureau at the American University,[1] Washington, D. C., during June, 1915. The p. m. means for the month are slightly higher than the 5-year means published in the Bulletin of the Mount Weather Observatory, 1912, **5** : 182, Table 3. A noon intensity of 1.43 calories measured on June 10, 1915, exceeds any measurement heretofore obtained at Washington in June.

Skylight polarization, measured at solar distance 90° and in his vertical, with the sun at zenith distance 60°, averaged 52 per cent, with a maximum of 63 per cent. This latter is 7 per cent higher than the average maximum for June published in the Bulletin of the Mount Weather Observatory, **3** : 114, Table 16.

TABLE 1.—*Solar radiation intensities at Washington, D. C., during June, 1915.*

[Gram-calories per minute per square centimeter of normal surface.]

Date.	Sun's zenith distance.										
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.3°	79.8°	80.7°
	Air mass.										
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
1915. A. M.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
June 5		1.07	0.91								
7			1.06	0.98	0.91	0.84					
8			0.76	0.65							
9	1.21	0.98	0.83	0.80	0.78						
10	1.44	1.36	1.25	1.15	1.07	0.99	0.91				
18		1.04	0.87	0.82	0.76	0.66	0.60	0.55	0.51		
23		1.26	1.09	1.02	0.95	0.87	0.78	0.71	0.64		
25	1.08		0.85								
27		1.08	0.88	0.74							
28	1.41	1.30	1.21	1.12	1.05	0.97	0.89	0.81			
30	1.25	1.06	0.87	0.77							
Means	**1.28**	**1.14**	**0.96**	**0.89**	**0.92**	**0.87**	**0.80**	**0.69**	**(0.58)**		
P. M.											
June 8	1.40	1.26	1.17	1.07	0.99	0.92	0.85				
9		1.11		0.79	0.73	0.61					
10		1.34	1.21								
15	1.24										
23	1.29	1.18	1.08	0.97	0.88	0.80	0.74	0.68			
24		1.24	1.09	0.97	0.89						
25			0.94	0.82							
Means	**1.31**	**1.23**	**1.10**	**0.92**	**0.87**	**0.78**	**(0.80)**	**(0.68)**			

[1] For a description of exposures of instruments, and details of methods of observation, *see* this REVIEW, December, 1914, **42**: 648.

In Table 2, column 2 gives the daily totals of solar and sky radiation received on a horizontal surface at the American University. The measurements were made with a Callendar recording pyrheliometer as described in the REVIEW for March, 1915, **43** : 100. Table 2, column 3, gives the departures from the normals published in the same number of the REVIEW, page 108, Table 4.

The "Percentage of possible sunshine," and the "Average cloudiness," given in columns 5 and 6 of Table 2, have been taken from the records of the observatory at the central office of the Weather Bureau.

TABLE 2.—*Daily totals and departures of solar and sky radiation at Washington, D. C., during June, 1915.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily total.	Departure from normal.	Excess or deficiency since first of month.	Percentage of possible sunshine.	Average cloudiness.
	Gr.-cal.	*Gr.-cal.*	*Gr.-cal.*	*Per cent.*	*0–10.*
June 1	302	−228	− 228	26	9
2	71	−458	− 686	0	10
3	209	−320	−1,006	1	10
4	466	− 63	−1,069	54	6
5	578	50	−1,019	76	3
6	315	−213	−1,232	39	8
7	545	18	−1,214	75	4
8	635	108	−1,106	95	3
9	680	154	− 952	100	0
10	750	225	− 727	96	1
11	605	80	− 647	77	5
12	646	122	− 525	78	4
13	502	− 22	− 547	58	7
14	570	47	− 500	60	7
15	505	− 18	− 518	58	7
16	507	− 15	− 533	69	7
17	565	43	− 490	64	6
18	548	26	− 464	62	4
19	514	− 8	− 472	53	6
20	577	55	− 417	95	3
Decade departure			**310**		
21	514	− 9	− 426	41	9
22	622	99	− 327	66	5
23	753	230	− 97	99	0
24	739	216	119	92	3
25	615	92	211	97	2
26	390	−134	77	50	8
27	716	192	269	97	1
28	770	246	515	100	1
29	648	124	639	82	3
30	499	− 25	614	50	9
Decade departure			**1,031**		
Total excess or deficiency since first of year			**−1,058**		

The above data show more than the average cloudiness and less than the average sunshine during the first decade in June, but less than the average cloudiness and more than the average sunshine during the second and third decades, the excess of sunshine being especially marked during the third decade.

SYSTEMATIC OBSERVATION OF METEORS.

By Prof. S. A. MITCHELL,

Leander McCormick Observatory, University of Virginia.

[Extracted in part from the Scientific American, v. 113, No. 2, July 10, 1915, p. 48.]

* * * While the connection between meteors and comets is of the greatest importance, still meteor observations are of great value to the meteorologist as they tell him the height of the atmosphere, the drift of the upper atmosphere, etc. Meteors in a shower move in parallel paths. These objects, which are comparatively near to the observer, are projected by the eye backward to the celestial sphere, with the result that by perspective the meteors all appear to radiate from a point—or rather small area—in the sky. Those meteors nearest the radiant have usually the shortest paths, those farthest away the longest. The meteor * * * takes its name from the constellation in which the radiant is found. The accurate position of the radiant is specially desirable, and this may be found by anyone who exercises a little care and a little patience. The general plan for observing is to have a map before one, specially prepared for the part of the sky which the observer is watching, and put down on this map as accurately as possible the meteors as they are seen. If the meteor paths when projected backward are to intersect in the radiant, the positions of the individual meteors must be plotted with accuracy. This, however, with a little experience can easily be attained.

Prof. Charles P. Olivier, of the Leander McCormick Observatory of the University of Virginia, * * * has given the benefit of his experience in some printed rules, which if followed by a beginner, will make him a valued meteor observer. The National Academy of Sciences has awarded to the Leander McCormick Observatory a small grant for the purpose of encouraging meteor researches. Fortunately a series of valuable maps of the sky has just been published by Dr. Reynold K. Young, of the Dominion Observatory. To all those who will engage in systematic observations of meteors and who will write to the Leander McCormick Observatory, University of Virginia, a series of maps and a set of rules for observation will be sent free of charge. The directions for observing meteors as given by Prof. Olivier are as follows: Maps are prepared of the region of the sky that is to be specially observed on a given night. On a separate *second* sheet, a number of columns are ruled and headed as follows:

Observer: *C. P. Olivier.*
Place: *A. S. C., Decatur, Ga., U. S. A.*
Date: *1911, Oct. 19.*
Began: *10h 31m.*
Ended: *14h 25m.*
Condition of sky: *Clear 75 per cent of time; clouds and haze during 25 per cent.*

Time. (1)			No. (2)	Class. (3)	Color. (4)	Magn. (5)	Distance. (6)	Duration. (7)	Duration of train. (8)	Beginning. (9)		Ending. (9)		Accuracy. (10)	Serial No. (11)
										α	δ	α	δ		
H.	*m.*	*s.*					°	*Sec.*	*Sec.*	°	°	°	°		
10	*30*	*10*	*1*	*S*	......	*5*	*5*	*0.4*	*0.4*	....	....	....	....	*W*	*11-157*
	40	*30*	*2*	*S*	......	*5*	*12*	*0.4*	*0.4*	....	....	....	....	*N*	*8*
	42	*30*	*3*	*S*	......	*4*	*10*	*0.4*	*0.5*	....	....	....	....	*N*	*11-160*
	42	*40*	*4*	*S*	*G*	*1*	*8*	*0.6*	*1.5*	....	....	....	....	*F*	*1*
	52	*30*	*5*	*O*	......	*6*	*3*	*0.6*	*0.6*	....	....	....	....	*W*	*2*
11	*4*	*40*	*6*	*S*	*O*	*3*	*9*	*0.8*	*0.5*	....	....	....	....	*W*	*11-163*

(1) Usually to get time to within 10 sec. is quite accurate enough.
(2) The number of the meteor on the map used this night.
(3) {*O*=Orionid. *S*=any other.
(4) {*G*=green. *O*=orange, etc.
(5) Use ONLY number. Avoid bright, faint, etc.
(6) Estimated at time as check. Not measured from map.
(7 and 8) Estimated by "dead" reckoning. Most beginners estimate time too long.
(9) These four coordinates to be measured off and filled in later if necessary.
(10) {*W*=well observed.. *F*=fairly observed. *N*=not well observed.
(11) Filled in next day.

[Please use this form for all your future observations. Notes about any meteor may be written on the back, i. e., anything peculiar, as a curved path, etc.]

DIRECTIONS FOR OBSERVING METEORS.[1]

By CHARLES P. OLIVIER.

[Leander McCormick Observatory.]

For the information of new members who are just starting in this work, the following rules and suggestions are given:

(1) Choose a place of observation with as free a horizon as possible, far from arc or other bright lights, away from city smoke, and free from fog.

(2) Use a lantern which is unaffected by wind, while a table and chair generally save time and promote comfort.

(3) Provide a star atlas, the recording maps, the recording blanks, a long rod or rule, a watch, several sharp pencils, weights to hold down papers if windy.

(4) Observe only on clear nights—that is, when stars of the 5th magnitude at least are visible. Haze and moonlight by cutting out all faint meteors, make observing inadvisable.

(5) Except on rare occasions observations of less than one hour are not recommended. Two- to 4-hour periods are best. They should be continuous.

(6) Use record blanks furnished, following instructions given on specimen copy.

(7) The maps may either be traced from some standard atlas or bought. In the first case the atlas used must be recorded. The meteor's path is shown in length and direction by an arrow as $\xrightarrow{37}$, with the proper number. By means of a mimeograph several dozen copies may be made after the first has been traced, using the prepared ink for the first. This will save time immensely. A few hours of work would thus give more maps than could be used for a year or two.

(8) As to tracing the meteor's path upon the map correctly, experience only will show how each separate case must be handled. However, I suggest the following plan:

The whole problem is merely to determine accurately the end points of the path. Joining these points gives the correct trace on the map. Hence, if a meteor begins and ends exactly at two stars, the trace gives no trouble. This is not usually the case. But either end may often fall halfway, or some other easy fraction of the distance, between two stars. Then one can measure off this proportion on the map and plot as before. But a better way is this, especially for those who have to use maps traced from an atlas whose projection is bad for the region needed. It is never difficult to find some *one* point in the meteor's path. Then glancing backward along the rod, held parallel to the path in the sky, one readily picks up some star at a distance from which the meteor seemed to come. These two points determine its direction. Using the first star as reference point, one can estimate how many degrees of the path lay behind and how many before the said star, and so an excellent plot is obtained. This method, used with care, largely or entirely eliminates the projection errors from the radiant deduced, if the meteor begins within from 20° to 40° of it. This method is recommended for observers unable to obtain specially prepared meteor maps on the central projection. We are now able, however, to furnish such maps at very low cost to our members.

Members are strongly urged to read the chapters on meteors in such standard texts as Young, Moulton, Todd, and others. The article on meteors in the Encyclopædia Britannica will be found excellent. Many helpful articles often appear in Popular Astronomy and some of the foreign astronomical journals.

In closing it may be well to recall to the members the conditions of membership, which are only two: (1) That

[1] Being Bulletin No. 3 of American Meteor Society.

each member shall observe meteors when possible. (2) That reports are to be sent in at first of each month. These reports consist of the maps and blanks actually used when observing, with additional notes if necessary.

In case an observer may feel unable to undertake the full program of work as outlined, he can still do useful work by counting the number of meteors that fall per hour with careful notes as to the condition of the sky. Anyone who observes between July 20 and August 30 is sure to catch a large number of meteors. The number of meteors seen per hour increases from sunset to dawn, the greatest number generally being seen just before sunrise. The present time of year is a most auspicious one for the beginner in meteor observing. The weather is warm, so that observations can be made in comfort. During the latter half of July and throughout August a meteor may be seen by anyone who has patience enough to watch for 5 to 10 minutes, while two or three or even half a dozen may be seen in this time. The beginner should be cautioned against trying to observe when the sky is not perfectly clear, or when the moon is bright, for then only the very brightest meteors can possibly be seen. Most astronomical work is valuable only when followed up regularly and systematically, but each night's work on meteors is separate and valuable by itself. Each observer will get full credit for all of the work which he sends in to the Leander McCormick Observatory, which by the grant of the National Academy has become the central bureau for meteor observations in America. Here is a splended chance for amateurs to do real astronomical work. [And one may add real meteorological work also.—*Editor.*]

INTERNAL REFLECTION AS A SOURCE OF ERROR IN THE CALLENDAR BOLOMETRIC SUNSHINE RECEIVER.

By ERIC R. MILLER, Local Forecaster.

[Dated: Weather Bureau, Madison, Wis., June 7, 1915.]

The Callendar bolometric sunshine receiver has already been described in the Monthly Weather Review by Kimball,[1] and elsewhere by various investigators. It may be regarded as being, essentially, either a bolometer with both strips exposed, one blackened and the other bright, or a platinum resistance thermometer of the 4-lead compensated type having the thermometer coil blackened and the compensating leads including a bright coil of the same electrical dimensions as the thermometer coil, so that the only difference between the two coils is the blackening. Each coil or strip consists of fine platinum wire of about 12 ohms resistance, wound in two grids in series. The two pairs of grids are arranged checkerboard-wise, as shown in figure 1, upon a mica plate. In receiver No. 9864, the mica plate measures 6.0×6.2 cm, and the grids cover an area about 5.8×5.8 cm. The blackening consists of a coat of shiny enamel painted over and imbedding the "black" grids. The object of the instrument is to continuously register the vertical component of radiation from sun and sky. Hence, the grids are permanently fixed in a horizontal position.

In order to avoid the effects of wind, convection, rain, etc., the grids are sealed into an exhausted, ovoid bulb, part of which forms a hemispherical cover of about 9.1 cm. external diameter. A vertical section of the instrument is shown in figure 2.

It is obvious that reflection, refraction, absorption, and radiation by the glass cover, and by the metal cylinder in which the bulb is mounted, must modify the simple sine law of variation of intensity of the radiation received upon the plate. Of these errors that due to internal reflection alone will be considered here.

It is convenient to consider the bulb enclosing the receiving grids as made up of a hemisperical cover (*a* fig. 2) above the grids, a spherical zone (*b* fig. 2) immediately below the grids, next a conical zone (*c* fig. 2), and finally a spherical segment (*d* fig. 2).

The internal reflection of radiation by the hemispherical cover, *a*, takes the well-known form of the "caustic by reflection."[2] This is an exceedingly important source of error in the Callendar sunshine receiver. The entire beam (*A, B, C*, fig. 3) projected upon the interior surface of the hemisphere from M to N (fig. 3), less what is transmitted, is concentrated by reflection upon the base of the hemisphere between *A′* and *B′*. The intensity of the reflected light, and the distance that it extends into the

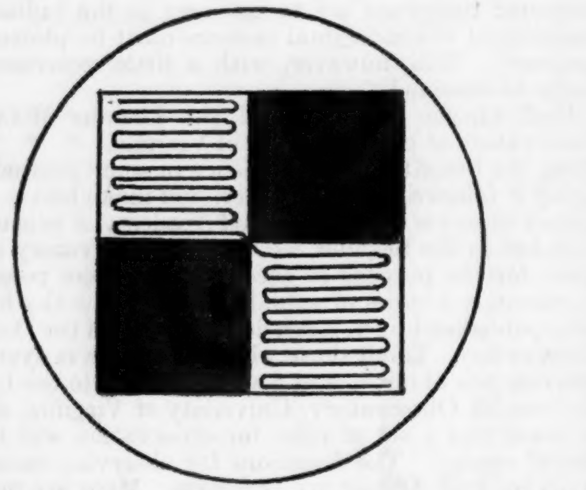

FIG. 1.—Plan of Callendar bolometric sunshine receiver. (Section through the receiving grids.)

hemisphere vary inversely with the elevation of the source of radiation above, or depression below, the plane of the base. According to the geometrical theory of the caustic, for plane waves incident parallel to the base, light reflected in this way extends into the hemisphere a distance equal to half of the radius. Inasmuch as the sides of the grids in the Callendar sunshine receiver extend 0.64 of the radius, and the corners of the grids 0.95 of the radius from the center, it is obvious that the caustic must fall upon the grids. Inspection of the instrument shows this to be the case.

In order to illustrate the changes of form and relative intensity compared with the illumination on a horizontal surface outside the hemisphere, for different elevations of the source above the plane of the base, a series of exposures of photographic plates has been made under a blown glass hemisphere, and are reproduced here in

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[1] Kimball, H. H. Total radiation received on a horizontal surface from the sun and sky. Monthly Weather Review, August, 1914, 42: 474-487. (Gives bibliographic references.)

[2] Watson, W. Caustics formed by reflection in "Textbook of Physics," London, 1902 pp. 470-472.
Wood, R. W. Reflection of plane waves from concave spherical mirrors, in "Physical Optics," New York, 1911, pp. 54-63.

figures 5 to 10. The angles of incidence and duration of exposure in making these plates were as follows:

Figure.	Angle of incidence.	Time exposed.
	°	*Seconds.*
5	0	60
6	10	24
7	20	12
8	30	8
9	40	6
10	50	5

The relative areas occupied by the grids of the Callendar sunshine receiver are indicated in outline by black lines on each plate.

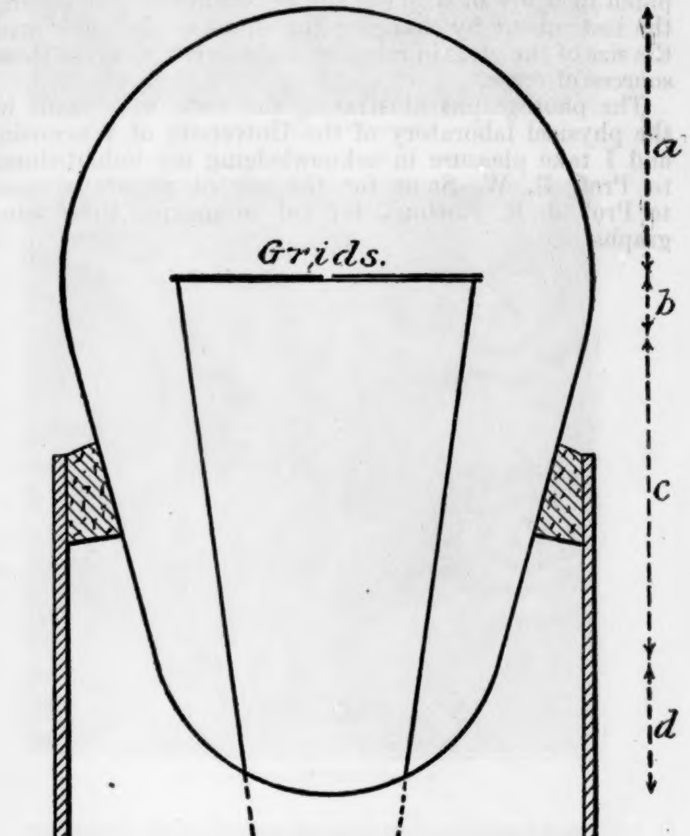

FIG. 2.—Vertical section through the Callendar bolometric sunshine receiver.

The V-shaped illuminated patch, figure 6, in the middle of the grid that the caustic crosses, is the caustic formed by light reflected from the surface of the photographic plate, the path of the ray in this case being as shown in figure 4. Similar caustics may be expected to result from any bright surface near the receiver and slightly below the horizon of the grids, or by reflection from the grids themselves. Reflection from the grids has the peculiarity that radiation projected in this manner falls mainly upon the grid opposite the source, which thus receives radiation reflected from all three of the other grids.

Turning now to internally reflected radiation from below, we have first the spherical zone, about 15° in width, then the conical surface (in Receiver No. 9864, a right

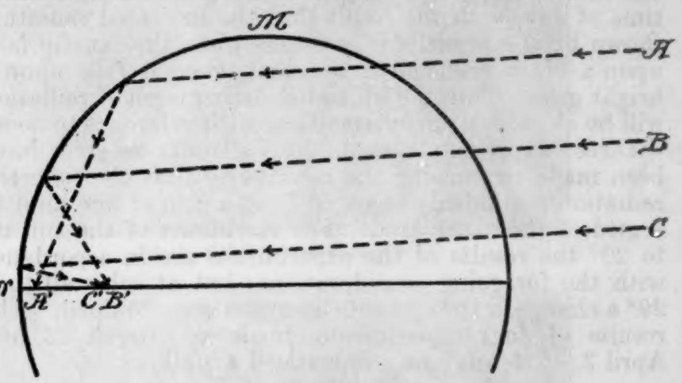

FIG. 3.—Formation of a caustic by the reflection of the beam *ABC* from the surface *MN* upon a plate at *A'B'C'*.

circular cone of 15° radius), and finally the spherical segment which is about 3 cm. in radius and about 6 cm. below the grids. The spherical zone forms caustics by reflection on the underside of the grids. These differ in form, but are more concentrated than those formed by the cover. They are of most importance when the source of radiation is low, since the zone is otherwise shaded by the grids. The conical surface is not of much importance since the source must be lower than elevation [solar altitude?] 15° for its reflected light to approach the grids, and then the conical surface is mostly shaded by the walls of the brass cylinder in which the bulb is mounted.

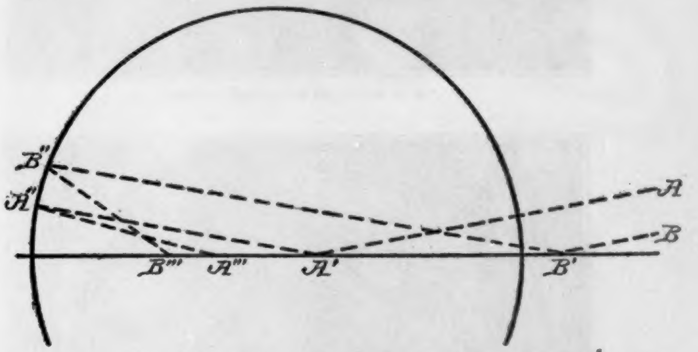

FIG. 4.—Formation of a caustic by internal reflection of light reflected from grids or other surfaces.

The spherical segment at the bottom of the bulb is shaded except for high elevations of the source of radiation, and if it were truly spherical would have no effect in concentrating radiation upon the grids. In all these cases of reflection from below it must be borne in mind that the grids are mounted upon a mica plate whose proper reflection and absorption must greatly diminish the amount of radiation transmitted to the grids.

Inasmuch as the Callendar sunshine receiver depends upon the difference in the temperature of the black and bright grids, it is easy to infer the nature of the error pro-

duced by the concentration of radiation upon one of the grids in any of the ways described above. When the excess of radiation falls upon a black grid the difference of temperature between the black grids and the bright grids will be increased and the indicated radiation will also increase. On the other hand, when the additional energy is delivered to the bright grids, both the difference and the indicated energy will be decreased. Since the position of the grids is fixed, while the radiation from the sun is projected successively around the interior of the hemisphere it must be received by a grid of one kind at one time of day and by a grid of another kind at another time of day, with the result that the indicated radiation shown by the recorder is in excess when the caustic falls upon a black grid and is deficient when it falls upon a bright grid. Thus the indicated daily march of radiation will be skewed, or unsymmetrical with reference to noon.

Direct experiments upon the Callendar receiver have been made by turning the receiver so that the reflected radiation is suddenly changed from a grid of one kind to a grid of the other kind. For elevations of the sun up to 20° the results of the experiments are in accordance with the foregoing considerations; but at solar altitude 29° a change in the opposite direction was obtained. The results of four experiments, made on March 23 and April 3, 1915, may be summarized as follows:

Sun's altitude.	Result of reversal (90° rotation).	
°	*Cal. min./cm.²*	*Per cent of total radiation.*
12	0.1	60
14	0.03	9
19	0.02	5
29	−0.06	− 8

In conclusion, it may be remarked that while it may be possible to obtain suitable correcting factors either analytically or empirically, their form would necessarily be so complex as to make their use exceedingly undesirable. The fact that the caustic theoretically does not extend more than a half-radius into the hemisphere, or actually two-thirds if we consider the doubly reflected patch in figure 6, suggests the possibility of redesigning the instrument by changing the shape of the cover and the size of the grids in relation to the cover, to avoid these sources of error.

The photographs illustrating this note were made in the physical laboratory of the University of Wisconsin, and I take pleasure in acknowledging my indebtedness to Prof. B. W. Snow for the use of apparatus, and to Prof. J. R. Roebuck for aid in making the photographs.

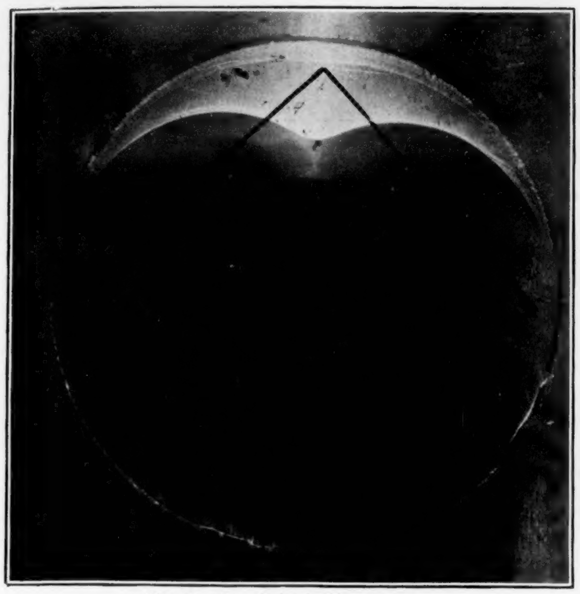

Fig. 5.—Caustic for incidence of 0°.

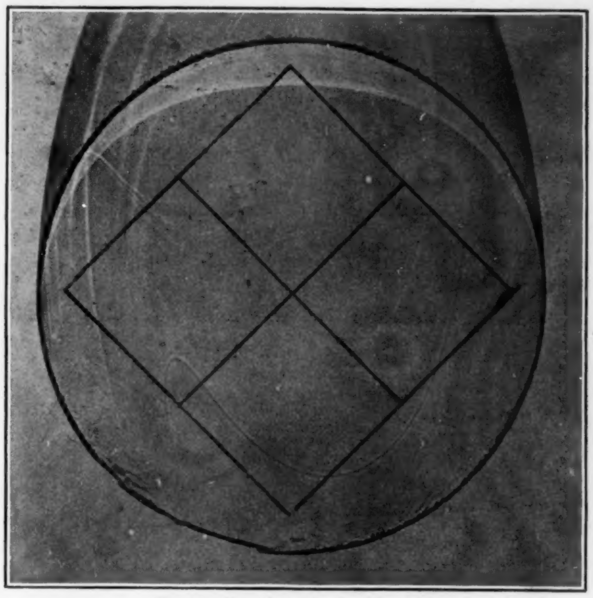

Fig. 8.—Caustic for incidence of 30°.

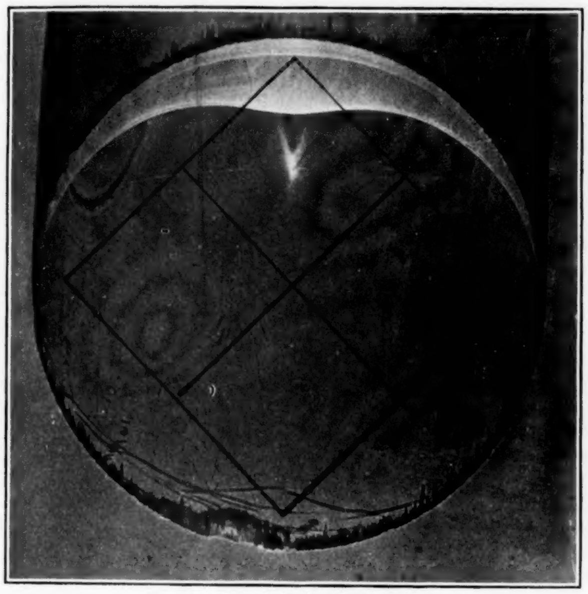

Fig. 6.—Caustic for incidence of 10°.

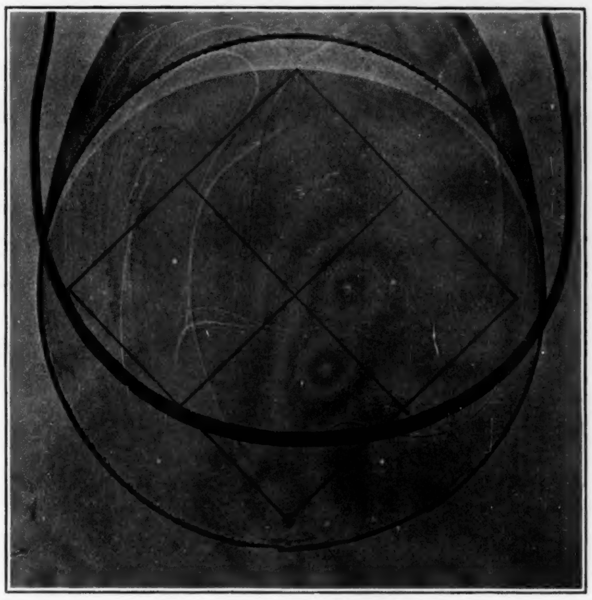

Fig. 9.—Caustic for incidence of 40°.

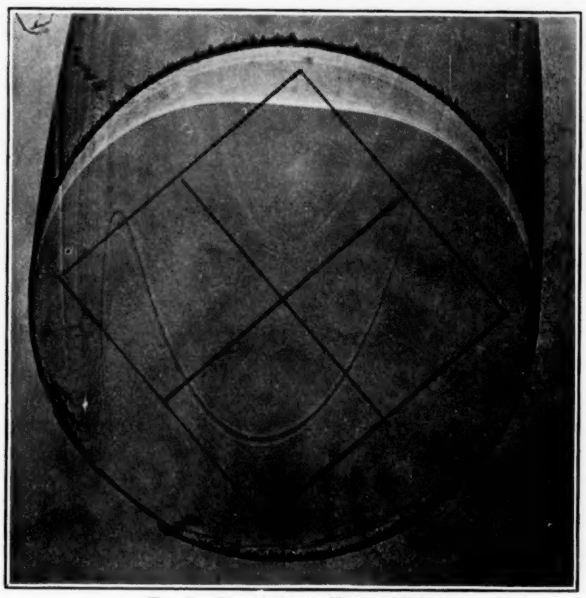

Fig. 7.—Caustic for incidence of 20°.

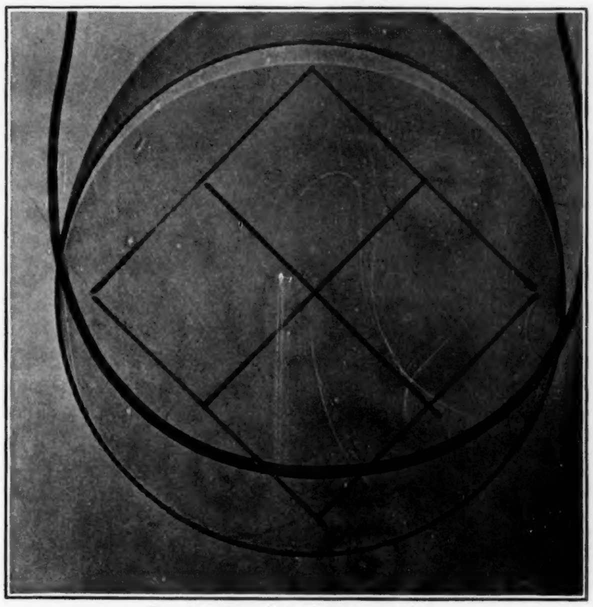

Fig. 10.—Caustic for incidence of 50°.

CAUSTICS OF REFLECTION ON A HORIZONTAL SURFACE WITHIN A GLASS HEMISPHERE.

SECTION II.—GENERAL METEOROLOGY.

V. RAINFALL AND AGRICULTURE IN THE UNITED STATES.

By B. C. WALLIS, B. Sc. (Economics).

[Dated: North Finchley, N. England, Feb. 24, 1915.]

The agricultural year.

The purport of the accompanying Table 1 is to display the facts regarding the growing period of the various crops in relation to the work of the farmer. The subdivisions of the table are intended by their cross-classification to direct attention to the variety of the rainfall circumstances which accompany the growth of the separate crops.

(i) The cereal States occur in five rainfall regions.

(ii) The cotton States similarly spread over five regions. These form the two chief divisions of the table; so that the remainder of the country could be divided upon a rainfall basis as follows:

(iii) The northeast, chiefly region F.

(iv) The central east, the similar regions K and L.

(v) The west coast, region C.

(vi) The Mountain States, regions D and E.

Note should be made of the fact that where a State—e. g., Missouri—falls into two rainfall regions the whole State has been grouped with the more important part; this implies a defect, yet the general and broad results to which this investigation leads are, in all probability, but little vitiated by this circumstance.

FIG. 43.—Approximate grouping of States as rainfall sections referred to in Table 1.

TABLE 1.—*The agricultural year in the United States.*[1]

	Beginning of sowing.	Beginning of reaping.	End of reaping.		Beginning of sowing.	Beginning of reaping.	End of reaping.
Wheat, winter,	A	*a*	**a**	Oats, fall,	F	*f*	**f**
Wheat, spring,	B	*b*	**b**	Oats, spring,	G	*g*	**g**
Rye, winter,	C	*c*	**c**	Maize,	H	*h*	**h**
Barley, fall,	D	*d*	**d**	Tobacco,	I	*i*	**i**
Barley, spring,	E	*e*	**e**	Cotton,	J	*j*	**j**

(*i*) **THE CEREAL STATES.**

States by sections. (See fig. 43.)	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
Section A.																																				
North Dakota										B		G	E	H	*						e	bg	e	bg	h	*	h									
Minnesota											BG		E*	H						ac	ac / e	bg	eg	b	A / Ch	*	h									
Montana														*							a		Aa		*											
South Dakota										BG	E		H	*						ac	ac / beg	e	bg	A	C		*		h				h			
Iowa									B	EG		*	H						ace	ac / bg	e	bg			A C			*	h					h		
Wyoming														*							a		A	a			*									
Nebraska									B	EG			H*						ac	ac / beg	e	bg			A C		h*								h	
Kansas						B	G	E			H	*						ace	eg	aeg / b	b				C	A			h*						h	
Section B (north).																																				
Wisconsin										B	G	E		H	*	I				ac	ac / be	ge	ibg		Ahi	C	h*									
Illinois								G	B			H*			I			ac	gac	b	bg			i	C	A	hi		*					h		
Missouri							G	E			H*				I		ac		eg / ac	eg				i	A C		hi		*						h	
Section F.																																				
Michigan										G		BE		H*						ac	eac	bg	e	bg	A C / h		h	*								
Section G.																																				
Indiana								G	E				H*		I		d	acd	eac	ge	g			i	A C / D		hi			*				h		
Ohio									EG				H*		I			ad	ced	gac	e	g	i		CD	Ah	i	h*								
Section H.																																				
Kentucky							G				H	*		I			acd	d	gac		g			i	CD	Ah	i		*			h				
(*ii*) **THE COTTON STATES.**																																				
Section B (south)																																				
Oklahoma				G	E			H		J		*				c	aeg		ac / eg						C	A hj		*						h		j
Texas			BG		H			J				*			afd	c	b f	ac	g b	d	g			j	h	C	A D	F	*			h		j		
Section H.																																				
Tennessee						G			H		*	J	I			a		g a		g			i		j		Ahi	*					j	h		
Mississippi				G				H	*	J						fg	f	g						j			h	F		*		h		j		
Alabama			G					H		J	*				f	ag	f	ag						j		h		A F	*					hj		
Georgia				G				H		J	*				cf	a	g c	af	g					j		C h		F	A *				h	j		
Arkansas				G			H			J	*		I			a	g	a	g				i		j		Ahi			*	h			j		
Section L.																																				
North Carolina						G			H		J*	I				f	acg	af	cg			i			Cji		Fh		A *				h	j		
South Carolina			B					H		IJ	*				cf	b	a c	abf		i			i	j		h	C	F	A	*				j	h	
Section M.																																				
Florida						H		J	I		*		f			f	i					i	j	h					Fh		*		j			
Section N.																																				
Louisiana						H			J*						f		f							j	h				F		h *				j	
(*iii*) **THE NORTHEASTERN STATES.**																																				
Section F.																																				
New York										G	B	E		H*		I			a	c	beg / ac	i	be	g	A C / hi		h	*								
Connecticut										G			H*		I				c	g	i c	g			Ch	i	h	*								
Vermont											G	B		E / H*							ac	A / beg / c	a	C / be	h g		h*									
New Hampshire													G	E / H*								eg		e	h g	*	h									
Rhode Island										G	*		H				c				c	g	g		C	h		h		*						
Massachusetts										G			H*	E	I					cg	eic	g	e	C		hi		h	*							
Areas P.																																				
Maine													G	E / H*									eg		eg	h	h*									

[1] This table is based upon the results of an inquiry into dates of farm operations as published in the Yearbook of the Department of Agriculture, U. S. A., 1910, pp. 489-493, and as kindly supplied for some western States by the Department of Agriculture.

* Limits of average period free from killing frosts.

TABLE 1.—*The agricultural year*—Concluded.

(*iv*) THE CENTRAL EASTERN STATES.

States by sections. (See Fig. 43.)	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21 30	1-10	11-21	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
Section K.																																				
Pennsylvania										{*BE* *G*}			*H**		*I*				*ac*	*b* ac	*eg*	e	*i* g		*A*	*Ch* i		h	*							
New Jersey										*G*			*H**					*c*	*a*	*g* ac		g			*C*	*A*	*h*		*		h					
Maryland								*G*				*H**			*I*			*ac*	ac	*g*	g		*i*		*h*	*A C*	hi			*						
Delaware												*H**						*a* a						*h*			h	*A*		*						
Section L.																																				
West Virginia									*G*			*H**			*I*			*ac*	a	*g* c	g			i	*h*	*A C*	i	h	*							
Virginia								*G*			*H**			*I*			*a*	c	*g* ac		g			*i*		{*A C* *h*}	i			*		h				

(*v*) THE WEST COAST STATES.

States by sections.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21 30	1-10	11-21	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
Section C.																																				
Washington															*						*a*		a		*A*					*						
Oregon															*						*a*		a			*A*	*									
California [2]																																				
Idaho [2]																																				
New Mexico [2]																																				

(*vi*) THE MOUNTAIN STATES.

States by sections.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21 30	1-10	11-21	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
Section D.																																				
Nevada															*				*a*				a			*A*	*									
Section E.																																				
Utah													*							*a*			a		*A*			*								
Colorado													*								*a*		a	*A*					*							
Arizona										*						*a*		a										*A*				*				

* Limits of average period free from killing frosts.

[2] No data available.

The main importance of Table 1 lies in its demonstration (1) of the concentration of the farmer's effort at two periods of the year, and (2) of the variety in the date of the summer period between the completion of the first sowings and the commencement of the harvest.

The blanks in the early parts of the year signalize the absence of field work, but the blank space which occurs down the summer and autumn months lacks this significance.

The summer sowings are, however, completed by June 10, except in the case of tobacco, which is planted until the end of the month. With the exception of winter wheat in South Carolina, which is sown up to December 8, the winter and autumn sowings are completed by the end of November and in most cases by the end of October.

As a general rule the sequence of crops as sown tends to be consistent throughout the country.

Certain important facts emerge from the table in relation to the rainfall régime of the areas.

I. The wettest month is usually avoided for harvesting operations; generally the harvest is taken in the period following the rainfall maximum. The rainfall maximum of sections G and H falls early so that harvesting may begin in June. In the central Eastern States, however the harvest tends to be completed before the rainfall maximum occurs. This circumstance is strikingly illustrated in the cotton States, where the cereal harvests are gathered before the heavy rains and the maize and cotton crops after the maximum has passed.

II. Generally the summer crops are sown almost immediately before the rains commence and the winter and fall crops immediately the heaviest rains are over; the fast-growing crops are well watered at once and the slow-growing seeds lie during a long period which is dry and cold.

III. The variations in the dates of spring sowings are governed by the dates on which the last killing frosts of spring fall due; this is remarkably shown in connection with the sowing of maize (Indian corn). It becomes, therefore, obvious that, while sowing is related to frost as well as to rainfall, there is a definite adjustment of harvesting operations to the rainfall conditions.

Rainfall during the growing period.

Table 2 is based upon Table 1 and is designed to demonstrate the adjustment of the growing period to the variations in precipitation which occur. The rainfall values are based upon the pluviometric coefficients set out in Part II (this REVIEW, January, 1915, p. 14, ffg.). It might be suggested that these rainfall values would have been more easily obtained by averaging the actual rainfall values which are published in the rainfall statistics issued by the Weather Bureau. Such a suggestion, however, is open to a definite objection. It has been admitted that the method of pluviometric coefficients provides a better knowledge of average monthly rainfall values on the ground that it smooths out the effect of accidental rain splashes; and the addition to the pluviometric coefficients of the generalized equipluves tends still further to provide a more accurate statement of the rainfall régime of the country. Consequently the extra labor involved in the calculations is well worth while.

TABLE 2.—*The total precipitation during the growing period of the crops.*

States.	Winter crops.				Fall crops.				Spring crops.											
	Wheat (*A*).		Rye (*C*).		Barley (*D*).		Oats (*F*).		Wheat (*B*).		Barley (*E*).		Oats (*G*).		Maize (*H*).		Tobacco (*I*).		Cotton (*J*).	
	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.
(i) The Cereal States.	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*	*Mo.*	*Inches.*
North Dakota									4	10	2⅔	7	3⅓	9	3⅔	10				
Minnesota	10⅓	22	10⅓	22					3⅔	14	2⅔	10	3⅔	14	3⅔	14				
Montana	11⅔	13																		
South Dakota	10⅔	18	10⅓	17					3⅔	11	3⅓	9	3⅔	11	5⅓	14				
Iowa	10	24	10	24					3⅔	14	3	11	3⅓	13	5⅓	17				
Wyoming	11⅓	12																		
Nebraska	10	20	10	20					3⅔	13	3⅓	12	3⅓	12	4⅔	17				
Kansas	9⅓	22	9⅔	23					4⅓	15	3⅓	10	4	13	6	20				
Wisconsin	10⅓	25	10	24					3⅔	13	3	11	3⅔	13	3⅔	14	2⅓	9		
Illinois	9⅓	27	9⅔	28					3⅔	14			3⅔	14	5	18	3	11		
Missouri	9⅓	27	9⅓	27							3⅔	16	4	13	5⅓	22	3	12		
Michigan	10⅓	26	10⅓	26					3⅓	10	3	10	4	11	3⅔	11				
Indiana	9⅔	32	9⅔	32	9⅓	30					3⅔	14	4	15	4⅔	17	3	11		
Ohio	9⅓	27	10	30	9⅔	28					3⅔	13	3⅔	14	4⅓	16	2⅔	11		
Kentucky	9	35	9⅓	36	9⅓	35							4	17	5	19	3⅓	13		
(ii) The Cotton States.																				
Oklahoma	9	24	9	23							4	12	4	16	5⅔	22			5	19
Texas	8	18	8⅔	20	9⅔	27	7⅔	18	4⅔	11			5⅓	14	6⅓	18			5	17
Tennessee	8⅓	22											4	22	6	24	3⅓	13	4⅓	17
Mississippi							8	27					4	19	6⅓	29			4⅔	20
Alabama	8	32					7⅔	32					4⅓	20	6	26			4⅔	19
Georgia	7⅔	30	8⅓	33			7⅔	30					4⅓	18	6	28			4⅔	21
Arkansas	8⅓	32											4	19	6⅓	29	3	14	4⅔	19
North Carolina	8	30	9⅓	36			8⅓	30					3⅔	15	6	28	3⅓	15	4⅔	20
South Carolina	8⅓	30	8	27			7⅔	27	4⅓	20					6	26	3⅓	15	4⅔	19
Florida							6⅔	24							6	28	2⅔	11	5	23
Louisiana							7⅓	33							6⅓	27			5	22
(iii) The Northeastern States.																				
New York	10	30	10⅓	32					3⅓	12	3	12	3⅔	13	3⅔	15	2	9		
Connecticut			10	38									3⅓	12	4	16	2	8		
Vermont	11⅔	37	11	34					3⅓	12	2⅔	10	3⅔	13	3⅔	14				
New Hampshire											2⅔	10	3	11	3⅔	14				
Rhode Island			9⅓	38									4	11	4⅓	15				
Massachusetts			11	38							2⅓	8	3⅓	11	4⅓	14	2	7		
Maine											3	10	3⅓	11	4	14				
(iv) The Central Eastern States.																				
Pennsylvania	10	31	9⅔	30					3⅓	13	3⅔	14	3⅔	14	4⅓	17	2⅓	10		
New Jersey	9⅔	37	9⅔	37									3⅓	13	4⅔	19				
Maryland	7⅓	26	7⅓	26									4	15	4⅓	18	2⅔	11		
Delaware	8⅔	29													4	15				
West Virginia	9⅓	32	9⅓	32									3⅔	15	4⅓	18	3	13		
Virginia	9	31	9⅓	32									3⅔	14	5	21	3⅓	15		
(v) The West Coast States.																				
Washington	10⅔	32																		
Oregon	10⅓	29																		
(vi) The Mountain States.																				
Nevada	9⅔	7																		
Utah	10⅓	12																		
Colorado	11	14																		
Arizona	8	14																		

In connection with the rainfall values it should be noted that the average total annual precipitation of the States varies from 10 to 50 inches, so that within this very large range it is an important fact to note that the agriculturist—no matter how extensive or how small the scale of his operations may be—tends to make a definite adjustment of his growing period in order to arrange for a definite total rainfall during the period of growth of each crop.

This adjustment becomes noticeable from a consideration of the following summary:

Summary showing limits of precipitation and rainfall in Table 2.

Crops.	Key letter.	Growing periods.		Precipitation.	
		Shortest.	Longest.	Least.	Greatest.
		Months.	*Months.*	*Inches.*	*Inches.*
Winter wheat	(*A*)	7⅓	11⅔	7	37
Winter rye	(*C*)	7⅓	11	17	37
Fall barley	(*D*)	9⅓	9⅔	27	35

Summary showing limits of precipitation and rainfall in Table 2—Con.

Crops.	Key letter.	Growing periods.		Precipitation.	
		Shortest.	Longest.	Least.	Greatest.
		Months.	*Months.*	*Inches.*	*Inches.*
Fall oats	(*F*)	6⅔	8⅓	18	33
Spring wheat	(*B*)	3⅓	4⅔	10	20
Spring barley	(*E*)	2⅓	4	7	16
Spring oats	(*G*)	3⅓	5⅓	9	22
Spring maize	(*H*)	3⅔	6⅓	10	29
Tobacco	(*I*)	2	3⅓	7	15
Cotton	(*J*)	4⅓	5	17	23

The range of variation shown above is, however, fairly wide and it is imperative to investigate the quality of each State as a crop producer before attempting to arrive at any more definite conclusions.

Relative agricultural produce.

Table 3 aims at the provision of material for the investigation of the relative merits of the several States in regard to crops.

The values in columns (*a*) and (*e*) of Table 3 form a kind of index numbers which indicate relative values of the crop; a high number signifies a combination of a large proportion of the area of the State devoted to this particular crop, with a high average yield per acre. The relative yield per acre is shown in columns (*b*), (*f*), and (*g*), and columns (*c*) and (*d*) show the proportion of the United States acreage given to the crop in 1910 and 1900, respectively. A State which has high values in all col-

TABLE 3.—*Relative agricultural produce.*

States.	Wheat.				Rye.				Barley.				Oats.				Maize.				Tobacco.			Cotton.			
	(*a*)	(*b*)	(*c*)	(*d*)	(*a*)	(*b*)	(*c*)	(*d*)	(*a*)	(*b*)	(*c*)	(*d*)	(*a*)	(*b*)	(*c*)	(*d*)	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*c*)	(*e*)	(*g*)	(*c*)	(*d*)
(i) The Cereal States.																											
North Dakota	935	10	145	63	2	12	7	10	230	15	136	84	485	21	46	22	51	23	2	....	....	....	....	....	....	....	....
Minnesota	768	15	119	115	24	19	57	33	363	23	178	112	772	28	78	61	562	32	15	11	....	....	....	....	....	....	....
Montana	25	25	10	2	1	23	....	....	4	34	7	2	68	43	10	2	....	....	....	....	....	....	....	....	....	....	....
South Dakota	475	13	74	60	8	18	17	2	285	22	142	37	465	26	43	21	705	28	19	14	....	....	....	....	....	....	....
Iowa	145	18	11	33	11	19	16	63	252	26	71	153	2,100	30	136	122	5,400	33	83	96	....	....	....	....	....	....	....
Wyoming	12	26	2	....	....	....	....	....	1	32	1	....	24	34	4	1	....	....	....	....	....	....	....	....	....	....	....
Nebraska	601	17	50	49	16	16	37	38	36	22	19	11	760	25	75	63	2,680	26	70	97	....	....	....	....	....	....	....
Kansas	899	14	90	110	3	14	19	79	68	17	41	67	250	28	40	50	2,000	20	78	102	....	....	....	....	....	....	....
Wisconsin	64	19	4	19	88	17	150	120	380	28	119	85	1,260	32	66	71	910	33	14	15	34	10	24	....	....	....	....
Illinois	625	15	42	32	20	17	35	46	15	29	4	4	1,740	32	130	128	5,680	35	93	85	1	7	1	....	....	....	....
Missouri	390	13	37	35	3	14	7	6	....	....	....	....	200	27	22	33	3,150	29	73	77	....	....	....	....	....	....	....
Michigan	235	17	18	29	93	16	173	45	30	26	9	13	650	29	43	34	970	33	18	13	....	....	....	....	....	....	....
Indiana	1,140	16	53	28	24	16	17	20	6	25	1	2	1,100	29	53	50	4,400	36	45	48	15	8	22	....	....	....	....
Ohio	850	19	39	34	23	17	28	19	18	27	4	8	975	32	50	39	3,150	38	35	35	62	8	75	....	....	....	....
Kentucky	233	12	15	22	4	13	6	14	....	....	....	....	85	21	5	16	2,270	28	32	32	250	7	382	....	....	....	....
	....	16	709	640	....	17	569	495	....	25	732	578	....	29	801	713	....	30	577	625	....	8	504	....	....	....	....
(ii) The Cotton States.																											
Oklahoma	212	13	32	23	1	14	2	....	9	25	4	....	171	27	18	....	1,700	19	51	6	....	....	....	3	163	68	22
Texas	34	12	25	30	....	....	....	....	....	....	....	....	78	28	20	27	630	20	77	56	....	....	....	3	116	315	284
Tennessee	204	11	19	28	2	12	4	7	....	....	....	....	77	21	6	13	1,910	24	33	34	44	7	69	2	180	23	31
Mississippi	....	....	....	....	....	....	....	....	....	....	....	....	37	18	5	6	880	18	28	28	....	....	....	7	206	100	119
Alabama	19	11	3	2	....	....	....	....	....	....	....	....	71	18	8	11	860	15	31	32	....	....	....	7	188	110	123
Georgia	44	10	5	13	3	9	7	10	....	....	....	....	74	18	10	17	890	14	40	41	....	....	....	7	188	150	140
Arkansas	31	12	4	6	....	....	....	....	....	....	....	....	67	24	5	12	910	21	25	29	....	....	....	4	188	69	74
North Carolina	108	10	13	14	4	9	7	29	....	....	....	....	63	17	5	13	910	17	28	30	95	5	175	3	208	44	52
South Carolina	89	10	9	6	1	10	2	2	....	....	....	....	121	21	6	9	870	16	21	23	13	7	24	8	215	78	95
Florida	....	....	....	....	....	....	....	....	....	....	....	....	73	16	1	1	120	12	6	6	2	7	2	2	112	8	6
Louisiana	....	....	....	....	....	....	....	....	....	....	....	....	10	20	1	1	630	22	22	18	....	....	....	4	162	30	51
	....	11	110	122	....	11	22	48	....	25	4	....	....	21	85	110	....	18	362	303	....	7	270	....	175	995	997
(iii) The Northeastern States.																											
New York	164	20	9	9	65	17	85	133	42	26	11	59	775	31	38	59	430	35	6	6	8	11	5	....	....	....	....
Connecticut	....	....	....	....	42	19	5	9	....	....	....	....	68	32	....	....	430	42	1	1	215	15	11	....	....	....	....
Vermont	3	24	....	....	4	16	1	1	46	31	2	6	290	36	2	4	230	38	1	1	....	....	....	....	....	....	....
New Hampshire	....	....	....	....	....	....	....	....	5	25	....	2	45	35	....	1	110	38	....	....	....	....	....	....	....	....	....
Rhode Island	....	....	....	....	....	....	....	....	....	....	....	....	51	30	....	....	320	36	....	....	....	....	....	....	....	....	....
Massachusetts	....	....	....	....	11	17	2	5	....	....	....	....	29	34	....	....	210	40	1	....	43	15	4	....	....	....	....
Maine	6	26	....	....	....	....	....	....	10	30	1	4	133	37	4	5	16	40	....	....	....	....	....	....	....	....	....
	....	23	9	9	....	17	93	148	....	28	14	71	....	34	44	69	....	38	9	8	....	14	20				
(iv) The Central Eastern States.																											
Pennsylvania	645	18	32	35	144	17	190	182	5	25	1	3	650	29	28	45	1,170	37	14	16	38	12	27	....	....	....	....
New Jersey	256	18	2	3	204	17	43	40	....	....	....	....	226	30	2	3	1,260	35	3	3	....	....	....	....	....	....	....
Maryland	1,300	17	16	18	34	15	10	16	3	31	....	....	78	27	1	3	2,240	34	6	7	80	6	23	....	....	....	....
Delaware	1,000	17	2	2	8	15	....	....	....	....	....	....	55	28	....	....	2,860	30	2	2	....	....	....	....	....	....	....
West Virginia	190	13	8	11	6	13	6	....	....	....	....	....	78	21	3	5	1,190	29	8	8	7	7	16	....	....	....	....
Virginia	21	12	16	19	7	13	10	22	1	29	....	....	77	20	5	13	1,140	25	19	21	98	7	130	....	....	....	....
	....	16	76	88	....	15	259	260	....	28	1	3	....	26	39	69	....	32	52	57	....	8	196				
(v) The West Coast States.																											
Washington	42	19	30	25	2	21	3	1	86	33	26	14	129	45	6	3	5	27	....	....	....	....	....	....	....	....	....
Oregon	151	21	15	28	2	17	7	4	22	31	9	11	98	35	9	7	4	28	....	....	....	....	....	....	....	....	....
California	122	16	19	66	8	14	29	24	196	27	193	307	34	34	6	2	11	35	....	....	....	....	....	....	....	....	....
	....	19	64	119	....	17	39	29	....	30	228	332	....	38	21	12	....	30	....	....	....	....	....	....	....	....	....
(vi) The Mountain States.																											
Nevada	9	29	1	1	....	....	....	....	2	36	1	....	2	43	....	....	....	....	....	....	....	....	....	....	....	....	....
Utah	60	25	5	4	1	18	1	2	6	40	2	2	26	46	2	1	4	30	....	....	....	....	....	....	....	....	....
Colorado	71	24	8	7	1	17	2	1	5	36	4	4	53	39	6	4	26	21	1	1	....	....	....	....	....	....	....
Arizona	3	25	....	....	....	....	....	....	7	38	5	....	1	38	....	....	2	33	....	....	....	....	....	....	....	....	....
Idaho	107	26	11	4	1	20	2	....	24	38	9	4	61	42	5	1	2	30	....	....	....	....	....	....	....	....	....
New Mexico	9	23	1	4	....	....	....	....	....	....	....	....	4	33	1	....	11	27	....	....	....	....	....	....	....	....	....
	....	25	25	20	....	18	5	3	....	38	21	10	....	40	14	6	....	28	1	1	....	....	....	....	....	....	....
Grand total	....	17	993	998	....	16	987	983	....	30	1,000	994	....	29	1,004	979	....	29	1,001	994	....	9	990	....	175	995	997

(*a*) Crop in bushels per square mile of total area of State.
(*b*) Yield in bushels per acre.
(*c*) Fraction of U. S. A. area devoted to the crop in 1910 (per mile).
(*d*) Fraction of U. S. A. area devoted to the crop in 1900 (per mile).
(*e*) Crop in tons per square mile of total area of State.
(*f*) Yield in hundredweight per acre.
(*g*) Yield in pounds per acre.

umns under any crop may be regarded as a very good grower of that crop.

Each crop may now be considered in detail; in each case the best States will be compared with an equal number of moderate States.

WHEAT.

Best six States: Indiana, North Dakota, Kansas, Ohio, Minnesota, Illinois.

Moderate six States: Virginia, New York, Wisconsin, Michigan, Tennessee, Georgia.

	Best States.	Moderate States.
Winter wheat, growing periods (months)	9⅓–10⅓	7⅔–10⅓
Winter wheat, rainfall (inches)	22– 32	22– 31
Spring wheat, growing periods (months)	3⅔– 4⅓	3⅓– 3⅔
Spring wheat, rainfall (inches)	10– 15	10– 13

It thus appears that winter wheat requires a rainfall of from 22 to 32 inches during a growing period of 10 months, and in this connection it may be noted that the Cotton States obtain this quantity of rain during a shorter growing period and that they also obtain a low yield per acre and have as a whole a declining acreage.

Spring wheat requires about four months and a rainfall of about 13 to 15 inches; the 10 inches in the Summary (p. 270) above is solely due to North Dakota, where the yield per acre is, on the average, low. The moderate States lack both time and rainfall, and the Cotton States, where spring wheat is not usually grown, have too much rainfall during the summer months.

RYE.

Best three States: Pennsylvania, Michigan, Wisconsin.

Moderate three States: Virginia, Nebraska, Illinois.

	Best States.	Moderate States.
Rye, growing periods (months)	9⅔–10⅓	9⅓–10
Rye, rainfall (inches)	24– 30	20–32

Winter rye requires about 27 inches of rain during 10 months. The Cotton States have a low yield, a short growing period, too much or too little rain, and a declining acreage. Minnesota and Kansas are States of small relative acreage which have too little rain.

BARLEY (SPRING-SOWN).

Best three States: South Dakota, Minnesota, Wisconsin.

Moderate three States: Kansas, Nebraska, Michigan.

	Best States.	Moderate States.
Spring barley, growing periods (months)	2⅔–3⅓	3–3⅓
Spring barley, rainfall (inches)	9 –11	10–12

Spring barley is best suited by about 3 months' growth and 10 inches of rainfall. North Dakota suffers from a poor yield with deficient rainfall and a short period; New York has too much rain. The Cotton States and those of the neighboring central-eastern area have too much rain during the three suitable summer months.

The deficient acreage under barley in Indiana, Ohio, and Kentucky may be associated with an excess of rainfall for spring-sown barley and an apparent failure to grow fall-sown barley successfully.

OATS.

Best four States: Iowa, Illinois, Indiana, Wisconsin.

Moderate States: Michigan, South Dakota, Minnesota, New York.

	Best States.	Moderate States.
Oats, growing periods (months)	3⅓– 4	3⅔– 4
Oats, rainfall (inches)	13–15	11–14

Oats are suited by about 14 inches of rain during a growing period of about 3⅔ months. The Cotton States contain about one-twelfth of the total oats acreage, have a small yield per acre and an excessive rainfall and growing period. Kentucky, Missouri, and North Dakota fail comparatively as producers of oats since they fail to provide the suitable conditions of rainfall.

MAIZE.

Best three States: Iowa, Illinois, Indiana.

Moderate three States: Nebraska, Kansas, Kentucky.

	Best States.	Moderate States.
Maize, growing periods (months)	4⅔–5⅓	4⅔– 6
Maize, rainfall (inches)	17–18	17–20

Maize flourishes with about 18 inches of rainfall during a growing period of about five months. Minnesota, South Dakota, and Wisconsin receive too little rain and the Cotton States[3] receive too much. It has been noted that the growing period of maize in the Cotton States is very prolonged, and this should be associated with the very poor yield per acre which is obtained.

TOBACCO.

Best three States: Kentucky, North Carolina, Virginia.

Moderate three States: Ohio, Tennessee, Pennsylvania.

	Best States.	Moderate States.
Tobacco, growing periods (months)	3⅓	2⅔– 3⅓
Tobacco, rainfall (inches)	13–15	10 –13

Tobacco apparently requires about 14 inches of rain during a growing period of about three months near to midsummer. The majority of the States in the central and northeastern areas lack rainfall; Connecticut forms the striking exception.

[3] Under the better cultivation given by the boys who compete for the "corn prizes" offered by U. S. Department of Agriculture the "Cotton States" have given *the highest yield of corn* (maize) *per acre* in U. S.—EDITOR.

COTTON.

Best three States: Georgia, Alabama, Mississippi.
Moderate three States: Texas, South Carolina, Tennessee.

	Best States.	Moderate States.
Cotton, growing periods (months)	4⅔	4⅓- 5
Cotton, rainfall (inches)	19-21	17 -19

Cotton is suited best by about 20 inches of rain during a growing period of 4⅔ months. No States outside the cotton belt can provide these conditions during the hottest months.

Sections A and B (north) are best suited to spring wheat; section A reaches the standard as regards spring barley and contains a progressive acreage which increased by about one third during the decade, 1901-1910. Sections F and B (north) are good for oats. Section B (north) approaches the standard for maize. The tobacco belt occurs in sections H and L, and the cotton belt includes rainfall sections B (south), H, and L.

Reference to the typical graphs shown on the map [4] makes it clear that successful crop growing does not tend to be limited to one type of rainfall per crop, and this diversity of association between crop and rainfall emphasizes the conclusions already attained, that the successful agriculturist arranges his growing season to suit the rainfall conditions which prevail in his neighborhood.

TABLE 4.—*Summary of Table 3 by rainfall sections.*

Sections. (See fig. 43.)	Wheat.			Rye.			Barley.			Oats.			Maize.			Tobacco.		Cotton.		
	Bu./A.	(c)	(d)	*Bu./A.*	(c)	(d)	*Bu./A.*	(c)	(d)	*Bu./A.*	(c)	(d)	*Bu./A.*	(c)	(d)	*Cwt./A.*	(c)	*Lbs./A.*	(c)	(d)
A	17	501	441	17	153	225	23	595	466	29	432	342	27	267	320					
B, north	16	83	86	16	192	172	28	123	89	30	218	232	32	180	177	9	25			
B, south	13	57	53	14	2		25	4		28	38	27	20	128	62			140	383	306
C; part of D	19	64	119	17	39	29	30	228	332	38	21	12	30							
F	20	27	38	17	266	193	27	22	80	32	83	98	35	27	21	14	20			
G	18	92	62	17	45	39	26	5	10	31	103	89	37	80	83	8	97			
H	12	46	71	12	17	31				21	39	75	24	189	196	7	451	192	452	487
K	18	52	58	16	243	238	28	1	3	28	31	51	34	25	28	9	50			
L	12	46	50	12	25	53				20	19	40	22	76	82	7	345	212	122	147
M										16	1	1	12	6	6	7	2	112	8	6
N										20	1	1	22	22	18			162	30	51
P; parts of D and E	25	25	20	18	5	3	38	22	14	39	18	11	28	1	1					
	17	993	998	16	987	983	30	1,000	994	29	1,004	979	29	1,001	994	9	990	175	995	997

(c) Area of the United States in the crop in 1910 (thousandths). (d) Area of the United States in the crop in 1900 (thousandths).

TABLE 5.—*Summary of Table 2 by rainfall regions.*

Sections.	Winter crops.				Spring crops.											
	Wheat.		Rye.		Wheat.		Barley.		Oats.		Maize.		Tobacco.		Cotton.	
	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.	Growing period.	Rainfall during growth.
	Mos.	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*	*Mos.*	*Inches.*
A	10	19	10	21	3⅔	13	3	10	3⅓	12	4⅔	15				
B, north	9⅔	26	9⅔	26	3⅔	14	3⅓	13	3⅔	13	4⅔	18	2⅔	11		
B, south	8⅔	21	9	22	4⅔	11	4	12	4⅔	15	6	20			5	18
C	10⅓	31														
F	10⅔	31	10⅓	33	3⅓	11	2⅔	10	3⅔	12	4	14	2	8		
G	9⅔	30	10	31			3⅔	14	4	15	4⅔	17	3	11		
H	8⅓	30	9	35					4	19	6	25	3⅓	13	4⅔	19
K	8⅓	31	9	31	3⅓	13	3⅔	14	3⅔	14	4⅓	18	2⅔	11		
L	8⅔	31	9	32	4⅓	20			3⅔	15	5⅓	23	3⅓	15	4⅔	19
Average of above values	9⅓	28	9⅓	29	4	14	3⅔	12	4	14	5	19	3	12	4⅔	19
Standard value	10	27	10	27	4	14	3	10	3⅔	14	5	18	3	14	4⅔	20

Relation between rainfall regions and crops.

In a broad way Tables 4 and 5 summarize Tables 3 and 2 respectively. The average values calculated in Table 5 confirm the standard values obtained by a different method—that of sampling—in the preceding section.

No rainfall section appears to provide the best conditions for winter wheat; section B (north) approximates most closely, and this region has progressed in acreage under winter wheat at the same rate as the whole country. Winter rye appears to succeed best in rainfall sections F and G; the lack of rain militates against section A.

Conclusion.

The methods adopted in this paper are almost entirely based upon average values, and hence the general conclusions are valid only in a broad way. It might be expected that the averages would eventually yield complete symmetry and agreement between the results; the fact that such symmetry is not found is important testimony for the validity of the conclusion enunciated at the end of the preceding section.

Attention has been concentrated upon rainfall for the definite purpose of determining the importance of the

[4] These graphs were omitted from figure 43 to avoid crowding; they presented the sectional rainfall marches detailed in this REVIEW, April, 1915, p. 177.

rainfall factor in the complex conditions of the environment of the agriculturist. In itself the rainfall regime of an area is typical of its latitude, its situation both on the continent and in relation to the ocean. Therefore, a close relationship between successful agriculture and definite rainfall conditions might have been assumed. It is the purpose of this inquiry to have laid bare, first, the validity of such an assumption, and secondly, the details regarding the relationship. It may be hoped that, in so far as agricultural progress results from purposeful guidance from without, the conclusions herein attained may serve as an indication of directions in which such progress may be most rapidly and easily achieved.

A REVOLVING CLOUD CAMERA.

By OLIVER L. FASSIG.

[Dated: Weather Bureau, Baltimore, Md., July 12, 1915.]

About 10 years ago a new form of camera was brought to my attention by its designer, Mr. Fred. W. Mueller, of Baltimore, with the hope that such a device might prove to be of value to meteorologists. The camera revolved upon a vertical axis by means of a spring motor, a complete revolution being made in from 5 to 10 seconds, depending upon the illumination. The image was thrown upon a film, which automatically unrolled as the camera revolved. By this means a picture was secured of the entire horizon of 360° and of the lower portions of the sky, projected upon a long and narrow sheet of paper. The device produced some very interesting and striking effects when applied to landscape photography, but where large angular sections were involved the relative positions of objects in the field of view were obviously much disturbed.

While this new camera was of general interest to me, I suggested to Mr. Mueller that a modification of his device, in order to make it possible to secure, by means of a single exposure, a complete picture of the sky from horizon to zenith and through 360° of azimuth, might prove to be of considerable value in the study of the forms and the distribution of clouds. The work of designing and constructing a suitable camera for this specific purpose was at once undertaken with enthusiasm by Mr. Mueller. Four or five years later official assignment to another field took me away from Baltimore before a camera was perfected which entirely satisfied the inventor. Upon my return to Baltimore, in the summer of 1912, one of the first visitors to call at the local office of the Weather Bureau was Mr. Mueller, bringing with him a new camera, designed and constructed by him, together with some excellent cloud photographs.

An examination of the camera and the preliminary photographs convinced me that a satisfactory method had been found for photographing, by means of a single exposure, the entire arch of the sky and all visible objects therein. The accompanying photographs, shown in figures 1 to 3, give a good idea of the general appearance and construction of the camera, while the sectional drawing, figure 4, shows how the rays of light from the various points of the sky pass through the lens and reach their proper positions on the sensitized plate or film, *bd*, within the camera.

The heavens as seen from any particular point appear to the observer as a dome, and it occurred to Mr. Mueller that to photograph the sky upon a circular plate would give a fairly true rendering of the relative positions of all objects in the sky at the time of the exposure. The photograph of the sky secured with this particular instrument is 12 inches in diameter (fig. 5), the zenith is in the center of the picture, and the horizon along the circumference. The exposure of the sensitized plate or film is accomplished in one uninterrupted operation through a wedge-shaped opening in the plate-holder cover while the plate in its holder revolves around its own axis, and the entire camera revolves around a vertical (zenithal) axis, in turn facing every point of the horizon.

The wedge-shaped opening in the plate-holder cover is about a quarter of an inch wide at the circumference of the plate and tapers to a point at the center. The vertical angle included during exposure, as the camera revolves, is 90° or from the horizon to the zenith. It will be seen, then, that, as the camera makes a complete revolution, it will include 180°, or the entire visible dome of the sky.

The body of the camera is so mounted that the plate makes an angle of 45° with the plane of the horizon and with the line to zenith. The upper segment of the revolving plate is exposed, the light from the zenith passing down vertically through the lens and striking the center of the plate, while the rays from the horizon reach the edge of the plate. (See fig. 4.)

As the camera revolves and the plate moves past the wedge-shaped opening in the plate-holder cover fresh segments of the sensitized plate are successively presented to the sky until the entire exposure is made, when the shutter automatically closes, just as it automatically opened at the beginning of the exposure.

An important feature of the instrument is the automatic shutter. The plate is contained in a circular holder, upon the cover of which is the shutter. When an exposure is to be made the cover is raised away from the plate holder—by means of the screws seen on the outside of the camera in figures 1 and 2—which then becomes a fixed part of the camera cover. This operation brings the shutter beneath the lens and at the same time automatically sets it for action.

As the plate holder revolves around its own axis the camera revolves about a vertical axis, retaining its upright position, with the lens and shutter at the top. This is effected by guides which operate in a groove around the pedestal head. The relative rate of rotation of the camera and the plate is governed by the size of the large gears connecting them, shown in figure 3. The spring motor, by means of which the camera makes a complete revolution in from 5 to 10 seconds, is shown in position in figures 2 and 3. The lens subtends an angle of 90°, has a focal length of 3 inches, and is adjusted for objects at infinite distance.

The negative produced by means of the camera requires a certain correction in order to produce a picture of the sky which shall present all objects photographed in their true relations. The axis of revolution of the plate (*dba* in fig. 4) is at an angle of 45° to the axis of revolution of the camera. The lens is fixed at the center of the upper portion of the face of the camera. Hence, as the camera revolves, the image of the sky is apparently thrown upon the interior surface of an inverted cone. (See fig. 4, *abc*.) The apex of this cone, corresponding to the zenith, is at the center of the sensitized plate (fig. 5, *Z*), while the edge of the base, which limits the rays from the horizon, corresponds to the circumference of the plate. The sides of the cone subtend an angle of 90° and are equal in length to the semidiameter of the plate. The actual image is projected upon a revolving plane surface (the plate) which is tangent to the surface of the imaginary cone. The ratio of the area of the cone to the area of the circular plate is the same as the ratio of the base to the hypotenuse of a right triangle. Hence there

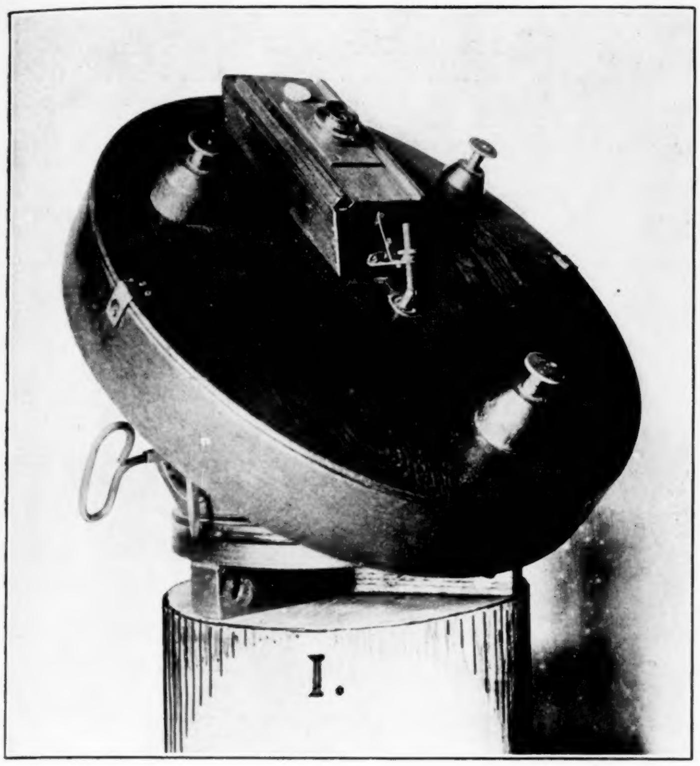

FIG. 1.—Front view of the Mueller cloud camera, showing the three screws for adjusting the plate holder and setting the shutter, and the method of mounting the lens.

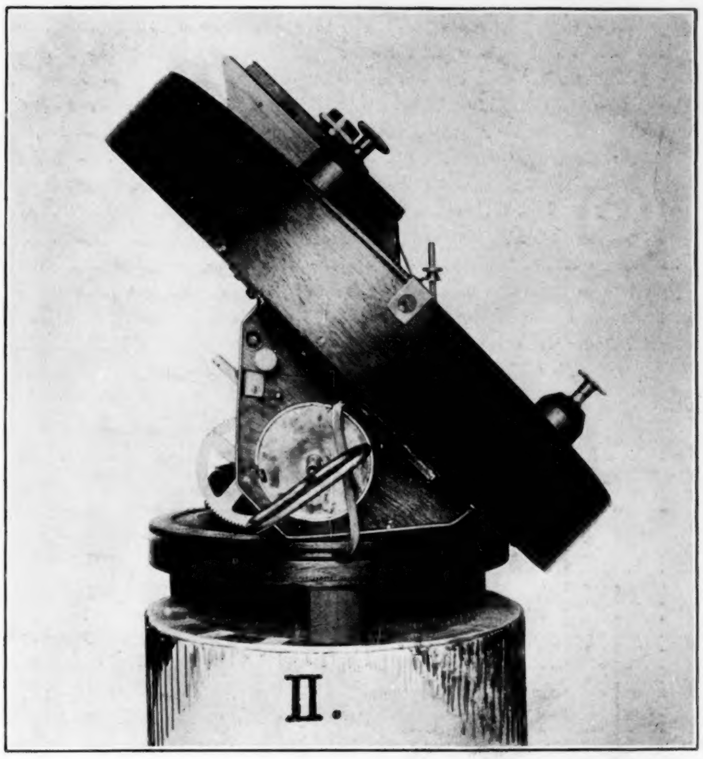

FIG. 2.—Side view of the Mueller camera, showing the inclination of the box to the horizon and part of the driving gear.

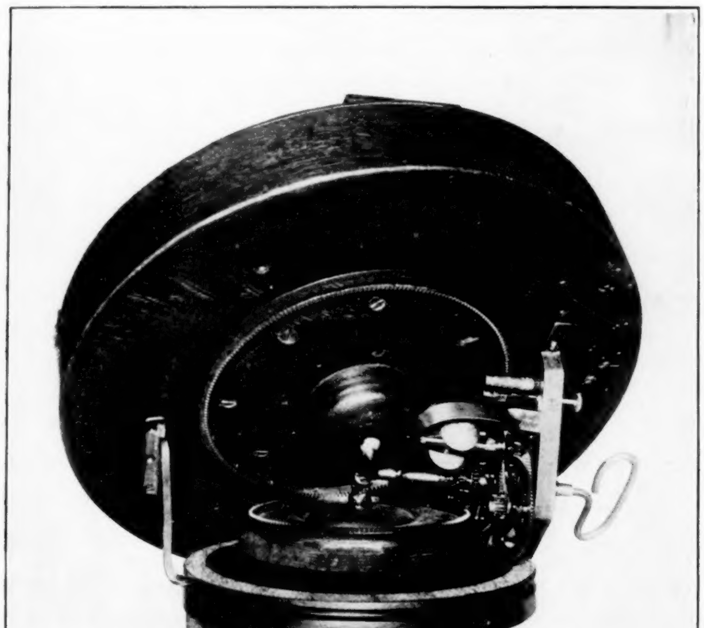

FIG. 3.—Rear view of the Mueller camera, showing the driving mechanism, the lower rack for revolving the whole box, and the inclined rack for rotating the plate holder within the box.

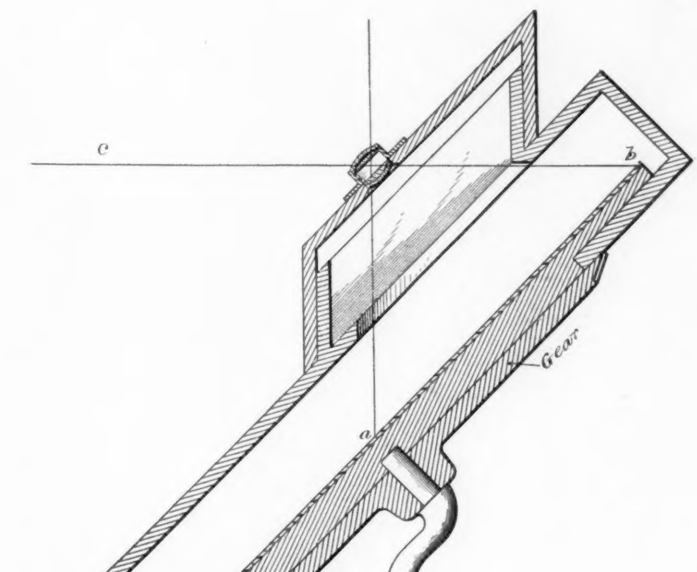

FIG 4.—Diagrammatic vertical cross section of the Mueller cloud camera, showing the cone of rays from the lens to the plate, *db*, and the cone, *cab*, to which the first print must be adjusted in order to secure the final picture shown in figure 6.

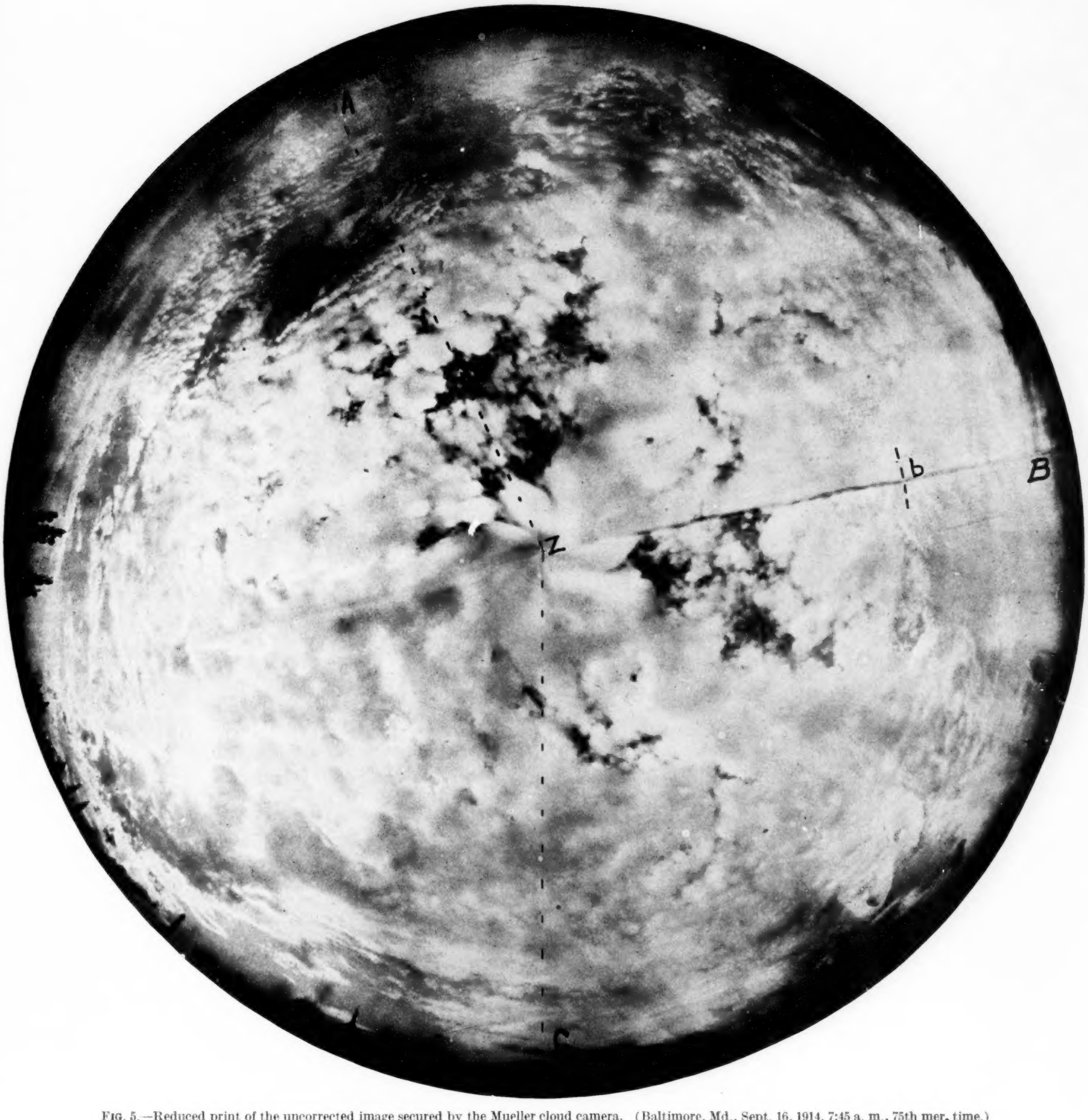

FIG. 5.—Reduced print of the uncorrected image secured by the Mueller cloud camera. (Baltimore, Md., Sept. 16, 1914, 7:45 a. m., 75th mer. time.) The segments AZB and BZC are duplicates; Z is the zenith. When this print has been corrected, its radius becomes Zb.

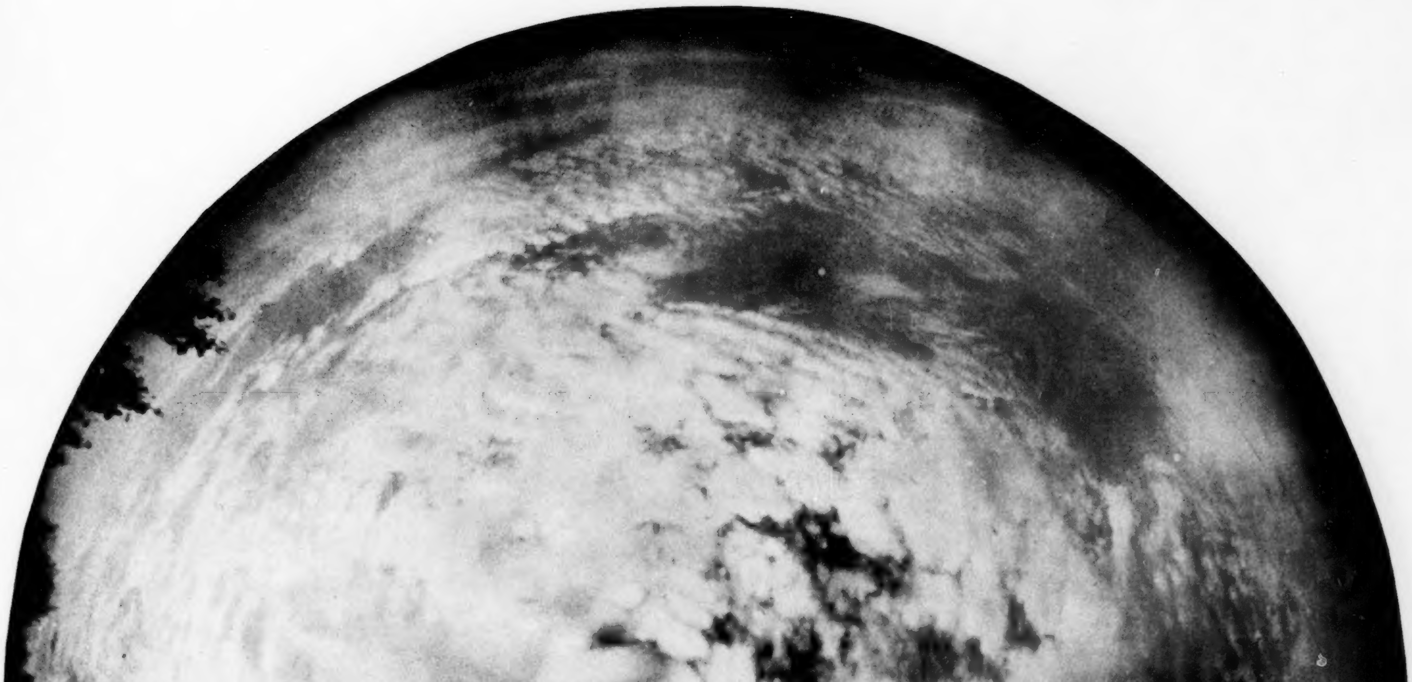

FIG 6.—Full-sized *corrected image* derived from the photograph shown in figure 5. (Baltimore, Md., Sept. 16, 1914, 7:45 a. m.

is a portion (AZB in fig. 5) of the sky image upon the negative which duplicates the first part of the picture. In order to obtain a correct picture of the sky the duplicating segment of the negative film is cut away and the edges are brought together. (In fig. 5 the segment BZC was cut away and ZB matched against ZC.) The final photograph, as shown in figure 6, is then made by means of transmitted light through the conical negative, which represents the dome of the sky. The sensitized circular film may be replaced by a conical film, with a slight modification in the construction of the camera. By the use of the conical film the size of the camera may be reduced, while the operation of cutting away the overlapping segment of the circular photograph is eliminated.[1]

Advantages of the new camera.

What advantages are offered by the use of the new form of camera, over the forms now in use, especially in the field of cloud photography? In the first place the new device can be utilized for all purposes now served by existing forms, and in addition yields results not to be obtained by means of the latter.

Our ignorance concerning cloud forms and their significance is still rather more conspicuous than our knowledge. It is reasonable to assume that a more accurate survey of cloud forms over an extended area and the rapid changes which they undergo will lead us to a better understanding of the nature and movements of storms and weather changes. A cloud is a visible process rather than a finished product, and is in many instances the only evidence we have of the forces at work in the upper atmosphere. A photograph which embraces the entire field of view opened up before the observer, and depicts all of the cloud forms—their relative positions and their extent—is manifestly of greater value than a photograph which shows only a small detached cloud, or portion of a cloud, and which gives no evidence of relationship with the general condition of the sky.

The problems of cloudiness may be profitably studied by means of a detailed study of individual cloud forms, just as it is a common and profitable practice to study forestry by the study of individual trees; there are, however, problems of clouds in association with other clouds, which can not be successfully solved in this manner, just as there are problems of trees in association with other trees, or the larger problems of forestry, which the study of individual trees will never suggest. The new form of camera will make such general cloud studies possible and profitable.

One of the simplest and most obvious uses of the new camera is to obtain a permanent and true record of the amount and character of the cloud cover at stated intervals during the day. The only method now in use to obtain this end is by means of eye observations, which are liable to errors of judgment, and at best are only rough estimates of the proportions of the sky covered by the principal cloud forms.

Photographs of the sky at stated intervals, taken simultaneously at a number of stations within cyclonic and anticyclonic areas, would afford valuable material for the advancement of our knowledge of storms. Assuming that one of these photographs will show the amount and character of the cloud cover over the area of from 200 to 300 square miles, a comparatively few stations equipped with the new camera would furnish detailed information as to practically every kind and phase of cloud form within the area of a well-developed cyclone or anticyclone.

The design of the new instrument seems to be entirely satisfactory, and the cloud photograph here reproduced in figures 5 and 6 was made by Mr. Mueller by means of the temporary wooden camera, constructed entirely by himself and shown in figures 1–4. It is very desirable, however, to provide for the construction of a more permanent instrument, in order to facilitate further experimentation in the technique of cloud photography, and to demonstrate the value of the camera as an instrument for systematic research, and for daily use at meteorological observatories.

[1] Mr. Mueller is now constructing such a modified model with a conical film in accord with these suggestions—O. L. Fassig.

A TEST FOR PERSONAL ERROR IN METEOROLOGICAL OBSERVATIONS.

By ERIC R. MILLER, Local Forecaster.

[Dated: Weather Bureau, Madison, Wis., Mar. 23, 1915.]

The object of this paper is to call attention to the value of the daily rainfall-frequency distribution as internal evidence as to the reliability of climatic data. Internal evidence is often the sole dependence of the climatologist in weighing raw data, since the observers are necessarily isolated, and hence are not subject to personal inspection and supervision. The degree of neatness of the observer's reports affords only indirect evidence of the fidelity with which the observations have been made, especially as the majority of volunteer observers—the principal source of climatic data—are likely to be above the average in general education, although they may have had no training whatever in scientific accuracy. Even this indirect evidence is not available to many who have only the neatly printed tables of data presented to their inspection.

Rainfall-frequency distribution is determined by classifying the recorded daily rainfalls according to magnitude, one class for each unit of the scale used in measuring rainfall. In the United States rainfalls are recorded to hundredths of inches, hence such a table shows the number of daily rainfalls of "Trace," 0.01 inch, 0.02 inch, 0.03 inch, and so on, in ascending series.

The frequency distribution of daily rainfalls is of the "extremely asymmetrical or J-shaped form"[1] of the statistician, the smallest amount being most frequent. In order to show that the J-shaped frequency distribution of daily rainfalls prevails throughout the widely differing rainfall regimes of the United States, I present in Table 1, and figures 1 to 5, inclusive, and figure 15, frequency distribution tables and curves for 15 United States Weather Bureau stations in the arid Southwest, the north Pacific coast, the upper Mississippi and Ohio Valleys, the Gulf States, the Lake Region and New England. These data are for the six months, April to September, inclusive, in the year 1914. Longer series would give smoother curves, as is indicated by taking the average shown graphically in figure 15. The six warmer months were chosen in order to secure, as far as possible, impersonal data, since the automatic raingages at regular Weather Bureau stations are then in operation, and while the recorded measurements are personal stick measurements, they are likely to adhere quite closely to the automatic records, especially for small amounts.

[1] Yule, G. Udny. Theory of statistics. London, 1912. p. 98.

Table 1.—*Rainfall frequency distribution—Number of times various daily rainfalls (April to September, 1914, inclusive) have been recorded by automatic raingages.*

Station.	Amounts.																											Rainy days.*
	Trace.	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25-0.99	1.00+	
Winnemucca, Nev	15	3	3	2	1	....	2	4	....	1	1	1	1	....	....	1	1	1	....	....	....	....	....	....	....	6	1	29
Reno, Nev	16	4	2	....	....	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	12
Phoenix, Ariz	28	2	3	1	1	1	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	11
Portland, Oreg	13	11	1	....	3	2	....	....	2	2	2	1	2	2	2	2	....	1	3	....	2	....	....	....	....	14	....	52
St. Paul, Minn	21	6	7	4	1	3	3	1	1	1	4	....	....	1	1	2	....	....	1	....	1	....	2	....	2	19	5	65
La Crosse, Wis	23	5	5	1	2	1	3	2	2	1	3	....	1	....	....	2	....	1	....	....	1	....	....	1	....	23	10	64
Madison, Wis	23	10	5	3	....	3	2	2	1	....	2	2	....	....	....	....	....	1	1	1	....	....	....	2	2	16	7	60
Milwaukee, Wis	34	6	6	2	3	3	3	....	3	1	....	2	1	1	....	1	3	4	....	1	....	....	3	1	....	18	5	67
Green Bay, Wis	15	10	5	2	3	1	2	....	2	3	1	1	....	1	....	....	1	....	....	....	1	1	1	1	1	24	8	68
Vicksburg, Miss	22	8	4	2	1	1	1	3	2	3	....	1	....	....	1	1	1	....	....	....	....	1	....	....	1	14	8	53
New Orleans, La	24	7	3	4	4	2	1	....	....	....	1	1	3	4	2	....	....	1	....	....	2	1	1	1	....	26	8	72
Mobile, Ala	16	5	4	4	1	1	1	....	1	....	....	2	....	2	1	1	....	2	2	....	3	2	....	1	1	21	9	64
Columbus, Ohio	22	6	3	2	1	3	3	1	1	1	2	....	....	....	....	1	2	2	1	1	2	1	....	....	1	16	1	51
Boston, Mass	27	1	6	3	1	3	4	2	1	....	1	1	....	3	....	....	....	1	....	....	....	1	....	....	1	17	5	51
Northfield, Vt	23	5	6	7	5	3	2	1	1	1	2	....	2	3	2	1	1	....	....	5	2	2	....	2	....	22	3	78
Total	322	89	62	37	27	29	28	17	17	14	20	12	10	17	9	12	9	14	8	8	14	9	7	9	9	240	70	797
Average	21.5	5.9	4.1	2.5	1.8	1.9	1.9	1.1	1.1	0.9	1.3	0.8	0.7	1.1	0.6	0.8	0.6	0.9	0.5	0.5	0.9	0.6	0.5	0.6	0.6	....	......	......

* Days having a fall of 0.01 inch or over.

Table 2.—*Abnormal frequency distribution produced by observational error—Number of times various daily rainfalls (April to September, 1914, inclusive) have been recorded by cooperative observers.*

Station.	Amounts.																											Rainy days.*
	Trace.	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25-0.99	1.00+	
Arthur, Nev	10	....	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	5	....	....	....	....	14	1	25+1
Gila Bend, Ariz	3	....	....	1	....	....	1	....	....	....	....	2	....	....	....	....	1	....	....	....	....	....	....	....	....	1	....	6
Salem, Oreg	1	4	3	1	2	3	2	4	....	....	1	....	1	1	....	....	....	....	....	1	2	....	....	....	....	19	....	44
Whitehall, Wis	5	....	....	....	....	....	....	....	....	....	11	....	....	....	....	....	....	....	....	....	9	....	....	....	....	27	5	52
Grantsburg, Wis	18	....	....	....	....	....	....	....	....	....	....	....	2	....	....	1	....	....	....	....	....	....	....	....	....	18	11	32
Neillsville, Wis	1	....	....	....	1	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....	1	....	....	20	9	33+1
Medford, Wis	....	....	....	3	....	2	....	....	1	....	5	1	....	....	....	5	1	1	....	....	2	....	....	....	....	29	6	56
Koepenick, Wis	....	....	....	....	....	....	....	....	....	....	8	....	....	....	....	....	....	....	....	....	9	....	....	....	....	14	9	40
Port Washington, Wis	....	1	....	3	....	3	....	....	1	....	2	....	1	....	1	2	....	....	1	....	2	....	1	1	1	19	6	45
Oconto, Wis	....	1	2	....	1	3	1	1	....	1	1	....	1	....	....	2	....	1	1	....	2	....	1	1	....	23	8	51
Woodville, Miss	8	....	1	5	2	7	2	3	....	....	1	1	....	....	....	1	....	1	....	....	....	....	....	1	....	25	8	58
Waynesboro, Miss	28	....	3	....	....	5	....	....	2	....	4	....	1	....	....	1	....	....	1	....	4	....	1	....	....	19	9	50
Hattiesburg, Miss	8	....	....	....	....	....	....	....	....	....	1	....	....	....	1	....	1	....	1	....	1	....	1	....	1	13	11	31
Frankfort, Ohio	8	....	....	....	1	6	....	....	....	....	1	....	....	....	....	2	....	1	....	....	1	....	....	....	....	17	4	33
Cornwall, Vt	12	2	2	....	....	9	....	....	1	....	8	1	....	....	....	1	1	....	....	....	7	2	1	....	....	22	3	60
Total	102	8	11	13	7	38	6	8	6	1	48	6	6	1	2	15	4	4	4	1	44	2	6	3	2	280	90	616
Average	6.8	0.5	0.7	0.9	0.5	2.5	0.4	0.5	0.4	0.1	3.2	0.4	0.4	0.1	0.1	1.0	0.3	0.3	0.3	0.1	2.9	0.1	0.4	0.2	0.1	....	......	......

* Days having a fall of 0.01 inch or more.

The advantages of the frequency-distribution table, or curve, of rainfall as a test for personal error are as follows:

(*a*) The smallest amounts being most frequent make it very sensitive to observational error of any systematic kind, since the smaller amounts are less likely to be considered important by the careless or neglectful observer.

(*b*) The data are easily available, and easily reduced for the purpose, the operation consisting merely of counting.

(*c*) It affords a means of comparing the work of different observers in different parts of the country, since the recording of rainfall is a universal duty of meteorological observers, and because the J-shaped curve prevails in widely different districts. The number of small rainfalls differs much less from one district to another, than does the total rainfall.

Examples of markedly abnormal frequency distribution of daily rainfalls are given in Table 2, and figures 6 to 14 inclusive. The majority of these are from Wisconsin because they had already come to my attention in studies of local climate and not because they are more common in that State than elsewhere. These data are for the same period as the data presented in Table 1 and figures 1 to 5, and are comparable therewith.

Three principal types of personal error are apparent from these examples, viz:

(1) Those due to the failure to record light rainfalls, see figures 6, 7, 8, 9, and 10.

(2) Those showing that rainfalls have been noted and not measured, but estimated as "Trace," see figures 11 and 12. The observer at Waynesboro has recorded a greater number of "Traces" than the regular station at New Orleans.

(3) Those showing that the rainfalls have not been accurately measured, but recorded to the nearest tenth or twentieth of an inch. Figures 13 and 14 (Arthur and Koepenick) show this practice to be consistently followed in the observations represented, while figures 10 and 12 (Cornwall and Waynesboro), show it to be followed in part only. This peculiarity is well known in connection with the *estimation*[2] of the tenths of degrees in observing thermometers graduated to full or half degrees, but the measuring stick used in rainfall measurements is full divided, so that this form of personal error can not be regarded as subconscious. The tendency to *estimate* to even amounts appears very strongly in measurements of snowfall (wherein the factor 1/10

[2] Walter, A. On errors of estimation in thermometric observations. Qly. jour., Roy. meteorol. soc., 1909, 35: 249-257.

is used to reduce to water equivalent) as is seen in the following record of rainfall frequency for Madison, Wis., for the month of January for the 20 years 1871–1890. (The tendency has since disappeared at this station.)

TABLE 3.—*Frequencies of various rainfalls at Madison, Wis., during 1871–1890, inclusive.*

Daily rainfall.	Frequency.	Daily rainfall.	Frequency.	Daily rainfall.	Frequency.
Inches.	*Days.*	*Inches.*	*Days.*	*Inches.*	*Days.*
Trace.	39	0.10	17	0.20	11
0.01	6	.11	1	0.21 to 0.24	2
.02	13	.12	3	.25	4
.03	11	.13	1	0.26 to 0.29	4
.04	3	.14	1	.30	6
.05	9	.15	7	0.31 to 0.39	6
.06	9	.16	2	[illegible]	7
.07	5	.17	2	0.41 to 0.49	2
.08	5	.18	0	.50	6
.09	1	.19	3		

A comparison of the total or average frequency of different amounts at the 15 regular stations in Table 1 will show a slight tendency to favor the fifth and tenth divisions, at the expense of the adjacent divisions. Among untrained observers the tendency becomes in some cases a ruling passion, as figures 13 and 14 and the average for the 15 cooperative stations in figure 15 clearly show. The following stations afford examples of markedly abnormal preference for the fifth and tenth divisions, corresponding to rainfalls of $0.05(2n+1)$ and $0.10n$ inches, where n is some whole number, throughout the whole range of recorded daily rainfalls, during the period considered, April to September, inclusive, 1914. Compared with the average frequency of "Trace" at the 15 regular Weather Bureau stations, 29 per cent, the percentage of "Trace" is evidently in excess at some, and deficient at others of these cooperative stations.

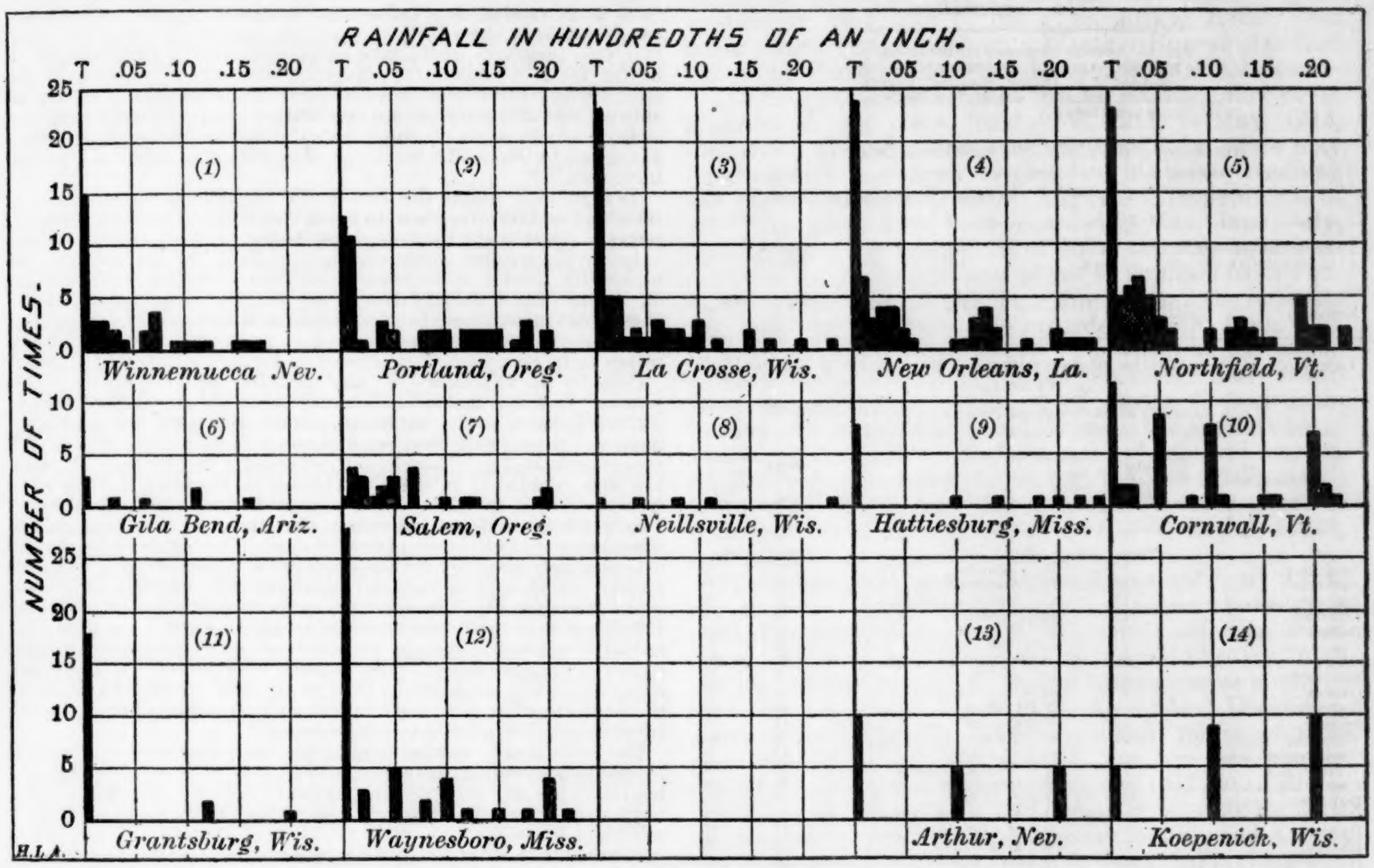

FIG. 1-14. Rainfall-frequency curves for 14 stations, April to September, 1914. *Abscissæ* show amount of the daily fall; *ordinates* indicate number of times each daily fall was recorded during the interval.

[The draftsman transposed some of these figures; imagine 13 under 6, 11 and 14 under 8, finally 12 under 9.]

TABLE 4.—*Examples of abnormal frequencies of the "5's" and "10's."*

Stations.	Relative frequency of the scale divisions: 5	0	1, 2, 3, 4, 6, 7, 8, and 9	Trace.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Koepenick, Wis.	0	100	0	0
Whitehall, Wis.	0	91	0	9
Arthur, Nev.	3	69	0	28
Cornwall, Vt.	30	32	21	17
Grantsburg, Wis.	30	30	4	36
Neillsville, Wis.	18	44	35	3
Waynesboro, Miss.	15	28	21	36
Frankfort, Ohio	**41**	**15**	**24**	**20**

Consideration of the probability of occurrence shows how unnatural these records are.

The influence upon the total rainfall for a month or a year, or upon the average rainfall, of these personal errors is probably not of any greater importance than the other errors affecting the measurement of precipitation. Their influence may, however, be felt strongly in other data relative to precipitation, perhaps most of all in the average number of "Rainy days." This effect is shown in Table 5, in which the regular Weather Bureau stations are set in black-face type.

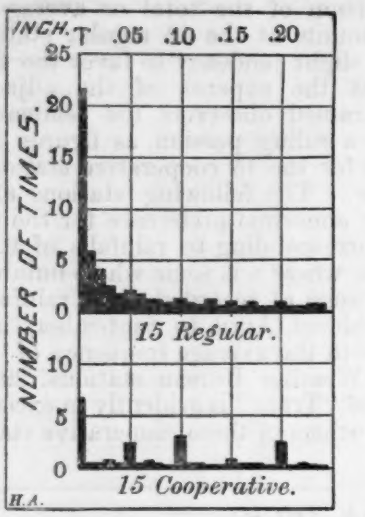

FIG. 15. Average frequency curves for daily rainfalls, April to September, 1914, as recorded at 15 regular Weather Bureau stations and at 15 cooperative stations. (See table below.)

Summary of daily rainfalls recorded in figure 15.

	Trace.	0.01 to 0.24	0.25 to 0.99	1.00 +
At 15 regular stations	322	487	240	70
At 15 cooperative stations	102	246	280	90
Coop./Regular.	32%	51%	117%	129%

TABLE 5.—*Average number of days with 0.01 inch or more of precipitation in Wisconsin.*

[From Summary of Climatological Data for Sections 58, 59, 60.]

Station.	Length of record.	Number of rainy days.	Station.	Length of record.	Number of rainy days.
	Years.	*Days.*		*Years.*	*Days.*
Ashland	16	78	Prentice	11	86
Barron	16	75	Stevens Point	17	78
Butternut	13	81	Valley Junction	18	89
Downing	15	73	Viroqua	19	100
Duluth	39	**131**	Wausau	14	102
Eau Claire	19	86	Amherst	16	81
Grantsburg	17	70	Appleton	10	108
Hayward	19	86	Beloit	17	77
Osceola	17	79	Brodhead	11	94
Red Wing	9	79	Chilton	15	101
Spooner	13	68	Crandon	11	70
Wabasha	14	88	Delavan	13	81
Weyerhauser	7	84	Florence	17	78
Whitehall	15	77	Fond du Lac	17	93
Dodgeville	10	78	**Green Bay**	23	**124**
Dubuque	36	**116**	Lake Mills	17	111
Grand Rapids	11	84	Madison *	31	111
Hancock	18	89	Manitowoc	17	98
Hatfield	12	69	**Milwaukee**	39	**128**
Hillsboro	19	76	New London	14	80
Koepenick	18	99	Oconto	18	96
La Crosse	37	**117**	Oshkosh	16	71
Lancaster	18	83	Pine River	15	94
Mauston	14	88	Port Washington	16	80
Meadow Valley	19	86	Racine	14	89
Medford	19	66	Shawano	13	88
Neillsville	21	56	Sheboygan	10	94
Portage	14	81	Watertown	18	100
Prairie du Chien	22	88	Waupaca	14	88

* 26 years cooperative, 5 years regular station.

The great differences between the records of stations manned by professional observers and those made by amateurs may be reduced to some extent by considering only the same period, but they are mainly due to differences in the fidelity to duty, as may be easily shown. This suggests the possibility of classifying observers with respect to fidelity to duty by arranging them in the order of the total number of rainy days reported by them.

The table, or curve, of frequency distribution of daily rainfall, however, gives a valuable insight into the observer's habits of work; its use can not well be omitted by working climatologists or the directors of climatological services without danger of loss of valuable time and effort in dealing with worthless or vitiated data.

REMARKS.

Prof. John F. Hayford, director of the College of Engineering, Evanston, Ill., presents by request the following comments on the above paper:

EVANSTON, ILL., *May 17, 1915.*

The use of the daily rainfall frequency distribution as a test for errors in the manner indicated in Mr. Miller's paper, seems to me to furnish interesting and suggestive indications of the habits of the observer and the character of the errors in the record turned in by him.

The value of these indications depends primarily upon the use which is made of them. Two general classes of use may be considered: (1) They may be used as a means of inspection of the observer and his work; and (2) they may be used as a guide in testing the accuracy of cooperative rainfall observations and as indicating how to reach safe conclusions from them.

If your observers would take suggestions kindly and seriously, if having found a cooperative observer's observations considerably in error it were possible to replace him by some one else, and if a considerable amount of inspection of a cooperative observer's work were possible, the indications obtained from the frequency-distribution tests advocated by Mr. Miller would be of considerable value as a part of inspection. * * *

As a guide in testing the accuracy of cooperative rainfall observations and as indicating how to reach safe conclusions from them, it seems to me that the frequency-distribution tests are likely to prove valuable if carefully considered and applied. In my opinion, the necessarily careful consideration involves traveling farther along Mr. Miller's line of thought than he has yet gone, judging by his paper. It may lead in some cases to added confidence in the records rather than the reverse The following paragraph is, possibly, a fair example of a reason for increased confidence based on frequency-distribution tests.

Consider the "Summary of daily rainfalls" under figure 15. This summary indicates that the cooperative observers missed 220 "Traces" (322−102) which may be estimated as 0.005 inch each, or a total of 1.1 inch; and 241 rainfalls between 0.01 and 0.24 inch (487−246), which may be estimated at 0.12 inch each, or a total of 28.9 inches. The total loss thus established in these two groups is, therefore, 1.1+28.9=30 inches. This is less than 10 per cent of the total shown in Table 2. This evidence indicates, therefore, that the total precipitation lost from the record in the form of smaller rainfalls which are unrecognized or erroneously recorded by the cooperative observers as a group, is possibly less than 10 per cent and almost certainly less than 20 per cent of the total amount. Are not other errors, in part unavoidable, probably larger than this? For example, is not the error in the total rainfall for a region produced by peculiarities in the geographical distribution of the stations and in the location with reference to the topography frequently much greater than 10 per cent? Will not any reduction in the number of cooperative stations tend strongly to increase the errors referred to in the preceding sentence?

The errors in the recorded total precipitation produced by the mere habit of concentrating the readings at 0.05, 0.10, 0.15, etc., are probably less than 5 per cent, and possibly less than 1 per cent—too small to be of importance. I reached this conclusion from a hasty study of Tables 1 and 2 and figure 15.

It seems to me that Mr. Miller's reasoning is conclusive in showing that the number of rainy days per year has one significance for regular stations and quite a different significance for cooperative stations.—*John F. Hayford.*

THE HOTTEST REGION IN THE UNITED STATES.

By G. H. WILLSON, District Forecaster.

(Dated: Weather Bureau, San Francisco, Cal., July 5, 1915.)

When the gold seekers and pioneers came to California in the early fifties many of them crossed the deserts in the southeastern portion of the State, and the intense heat experienced in that region during the summer months soon became well known and much feared. The sufferings of both man and beast while traveling over those dreary wastes have been the subject of many interesting papers, some of which were based upon facts while others were pure fiction. Undoubtedly many lives

have been lost in that region, and while the extreme heat has probably taken its toll, by far the greater number have perished from thirst.

It has long been believed that the hottest place in this country was in one of those depressions below sea level in southeastern California, Death Valley or the Salton Sea country. Until June, 1911, there was only a short record from Death Valley, but there were many long and reliable records from the latter which showed extremely high temperatures; therefore the Salton Sea country was generally considered to be the hottest place in the United States. It will surprise many persons to learn that not only the highest temperature in this country occurred in Death Valley, but that the highest shade temperature ever recorded in the open air with standard instruments and under approved methods of exposure in any portion of the world was recorded at Greenland ranch, on the edge of Death Valley, Inyo County, Cal., on July 10, 1913, when the thermometer registered 134° F. In fact, the record from this station for the period from July 8 to 14, 1913, inclusive, is probably the most remarkable authentic record of high shade temperatures ever made. The daily maxima during this intensely hot spell were: 8th, 128°F.; 9th, 129°; 10th, 134°; 11th, 129°; 12th, 130°; 13th, 131°; and 14th, 127°. During this time the temperature never fell below 85°F.

In the spring of 1911 arrangements were made between the United States Weather Bureau and the Pacific Coast Borax Co. to establish and maintain a Weather Bureau cooperative station at their place known as Greenland ranch, on the edge of Death Valley. This ranch is located on Furnace Creek at the eastern edge of Death Valley and 178 feet below sea level, but somewhat higher than the main floor of the valley. The ranch embraces about 100 acres of irrigated land on which alfalfa and some fruit and vegetables are grown. The meteorological equipment is that usually furnished to cooperative stations; it consists of Weather Bureau standard maximum and minimum thermometers, a raingage and a thermometer shelter. The shelter is of the regulation pattern, with louvered sides, a tight floor, and a double roof. The shelter is painted white with several coatings of white lead. The location for the instruments was carefully selected, the shelter being placed over an alfalfa sod, the floor about 4 feet above the ground, the shelter door facing north and about 50 feet from the nearest high object. The location is such that *the shelter is not exposed to the reflected heat from the desert.*

Evaporation is excessive in this section and liberal irrigation is necessary to maintain plant life; hence, the cooling by evaporation from the surrounding damp ground and live vegetation is probably sufficient to lower the readings of the instruments several degrees. Undoubtedly the temperature down in the desert bottom of the valley is much higher than it is at Greenland ranch.

The maximum thermometer in use during the hot weather of July, 1913, was graduated up to 135° F. only, and in a note accompanying his report at the close of the month, the observer stated that he doubted if the record was sufficiently high because other ordinary thermometers at the ranch showed a much higher temperature.

In order that the true value of this record may be appreciated, the following statement kindly furnished by Prof. C. F. Talman, Librarian, U. S. Weather Bureau, of other high temperatures reported in different portions of the world is submitted for comparison:

Greely's American Weather, page 128, mentions a temperature of 127.4° F. on August 27, 1884, at Ouargla (better spelled Wargla), on the edge of the Sahara desert, as "probably the highest registered by a trained observer from a reliable, well-exposed thermometer." This maximum has been repeated in meteorological works, down to the present time, as the highest well-authenticated temperature heretofore observed. However, Greely also (p. 129) mentions a temperature of 128°F. at Mammoth Tank, Cal., July, 1887, and this is also sometimes cited as the "record" for the world. Hann's Handbuch der Klimatologie (3d ed., vol. 3, p. 485) mentions a temperature of 131° F. (55°C.) as having been observed by the traveler, Stuart, in the interior of New South Wales, in January, 1845. In Thomson's "Introduction to Meteorology," p. 56, a temperature of 132°F. is said to have occurred near the Euphrates; while the Encyclopædia Britannica (9th ed., vol. 30, p. 810) states that 167°F., in the shade, has been observed in the desert of Gobi. I know of no other authority for this last extraordinary temperature record. In any case, the temperature of 134°F. at Greenland ranch remains the highest recorded for any definite station.

It appears strange that Gen. Greely should give the record of 128°F. in July, 1887, at Mammoth Tank, Cal., as the highest, when the records of that station show 130°F. on August 17, 1885, as stated in Weather Bureau Bulletin L. The old station at Volcano Springs, now under the waters of Salton Sea, has a record of 129°F. on June 23, 1902, and of 128°F. on July 5, 1905. This latter record was reached on a Weather Bureau standard maximum thermometer exposed in a standard shelter.

The temperature records at Greenland ranch now cover a period of four years, from June, 1911, to May, 1915, inclusive. Temperatures reaching 100°F. or more may be expected from April to October, inclusive; reaching the highest point in July or August. Temperatures of 120°F. or more have been recorded in May, June, July, and August. Temperatures of 80°F. or more have been recorded in all months, and of 90°F. or more from February to November, inclusive. The mean of the monthly maximum temperatures has exceeded 100°F. from May to September, inclusive, every year with one exception, when the record was 95.4° F. The average daily maximum temperature exceeded 110°F. twice in four times in June, and in every July and August; the greatest being 117° F. in July, 1911. In the months of July and August, for the four years under discussion, the mean daily maximum temperature has exceeded 115°F. three times in each month, the exceptions being 110.7°F. in July, 1912, and 111.4°F. in August of the same year.

The lowest temperature recorded was 15°F. on January 8, 1913. This low temperature occurred during a spell of exceptionally cold weather in California, when many long records of low temperature were broken in all portions of the State. Minimum temperatures of 32°F. or below have been recorded in November, December, January, and February. The mean daily minimum temperatures have been below 32°F. for but two months during the four years' record: January, 1913, when it was 26.5°F., and December, 1912, when it was 30°F. The mean monthly minimum temperature for July and August has exceeded 80°F., except in August, 1911 (78.9°F.), and July, 1912 (79.6°F.). The mean monthly temperature has exceeded 100°F. half of the time in both July and August; it has exceeded 90°F. in every June and for half of the time in September. The highest monthly mean temperature was 101.6°F. in July, 1914, and the lowest was 45.8°F. in January, 1913.

The maximum temperature has reached or exceeded 100°F. on 548 days in the four years from June, 1911, to May, 1915, inclusive, as follows: in April 15 times, May 72, June 108, July 123, August 124, September 97, and October 9 times; and reached or exceeded 120°F. on 59 days, as follows: May 2, June 5, July 25, and August 27 days.

The daily weather maps have been carefully studied for some peculiarity that would explain the extremely hot weather in Death Valley in July, 1913, but it is doubtful if a sufficient cause was found.[1] The weather type

[1] *Compare* Notes on the climate and meteorology of Death Valley, Cal., by Mark W. Harrington. Washington, 1892. 50 p. 8°. (Weather Bureau Bull. 1.)

was that which always causes high temperatures over the south Pacific coast district, it was not unusually pronounced, and did not give record temperatures in any other portion of California. The wind along the eastern slope of the Sierra was very light and from the north, causing a slow southward movement of the air from the high plateau and mountain regions of northern Nevada. As it was descending it was heated dynamically in passing down the western slopes of the Amargosa and Funeral Mountains to the deep valley below. Once in the valley the surface air probably became stagnant owing to the high walls at the south end, and was heated rapidly by the reflected heat from the rocks and desert floor of the valley.

The condition was probably local as is often the case in mountainous regions, and the exceptionally high temperatures were confined to Death Valley.

The following tables present the temperature records of this hottest station, by years and months:

TABLE 1.—*Temperatures recorded by Weather Bureau thermometers in a standard shelter at Greenland ranch, Inyo County, Cal.*

[Lat. 36° 27′ N.; long. 116° 50′ W. Alt., −178 feet, M. S. L.]

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
HIGHEST TEMPERATURE.													
1911	.....	.....	.....	.....	.....	120	122	122	118	100	90	80	122
1912	85	88	91	98	120	120	118	120	112	99	87	82	120
1913	82	90	98	109	120	119	134	124	116	105	90	74	134
1914	73	85	98	104	116	124	122	126	112	101	91	82	126
1915	76	75	92	101	113	.....	.....	.....	.....	.....	.....	.....	.....
Monthly extremes	85	90	98	109	120	124	134	126	118	105	91	82	134
LOWEST TEMPERATURE.													
1911	.....	.....	.....	.....	.....	63	72	69	60	51	27	22	22
1912	22	33	38	36	55	57	67	68	56	42	32	21	21
1913	15	30	36	47	52	60	70	74	66	60	58	52	15
1914	52	47	52	50	53	60	76	70	60	68	57	52	47
1915	50	43	45	56	52	.....	.....	.....	.....	.....	.....	.....	.....
Monthly extremes	15	30	36	36	52	57	67	68	56	42	27	21	15
MEAN TEMPERATURE. [½(mean max.+mean min.)]													
1911	.....	.....	.....	.....	.....	93.8	100.2	97.2	87.6	72.8	59.6	51.6	.....
1912	53.0	60.0	65.5	71.6	82.4	90.2	95.2	96.0	83.2	71.9	59.1	48.8	73.8
1913	45.8	57.3	63.2	77.2	84.8	92.4	98.6	100.4	92.6	82.4	72.4	61.8	77.4
1914	65.2	67.3	73.4	75.4	85.8	91.4	101.6	100.4	90.0	81.9	72.6	66.2	80.9
1915	64.6	61.8	69.8	78.1	80.4	.....	.....	.....	.....	.....	.....	.....	.....
Means	57.2	61.6	68.0	75.6	83.4	92.0	98.9	98.5	88.4	77.2	65.9	57.1	77.0
MEAN MAXIMUM TEMPERATURE.													
1911	.....	.....	.....	.....	.....	111.9	117.0	115.6	105.2	91.0	78.1	68.9	.....
1912	72.7	80.6	81.5	88.7	100.0	109.5	110.7	111.4	100.9	88.4	78.9	67.7	.....
1913	65.1	72.7	81.4	96.2	103.4	110.0	116.4	116.5	107.4	94.6	78.6	65.7	.....
1914	68.8	75.1	86.3	88.5	100.2	106.9	116.6	116.2	109.0	91.5	81.5	72.9	.....
1915	69.8	69.0	82.6	91.4	95.4	.....	.....	.....	.....	.....	.....	.....	.....
Means	69.1	74.4	83.0	91.2	99.8	109.6	115.2	114.9	105.6	91.4	79.3	68.8	91.9
MEAN MINIMUM TEMPERATURE.													
1911	.....	.....	.....	.....	.....	75.7	83.5	78.9	70.1	54.7	41.2	34.3	.....
1912	33.2	39.3	49.5	54.5	64.8	71.0	79.6	80.7	65.4	55.4	39.3	30.0	.....
1913	26.5	41.9	44.9	58.2	66.2	74.9	80.8	84.4	77.7	70.2	66.2	57.8	.....
1914	61.5	59.5	60.6	62.3	71.3	76.0	86.5	84.5	70.9	72.3	63.7	59.4	.....
1915	59.3	54.6	57.0	64.8	65.3	.....	.....	.....	.....	.....	.....	.....	.....
Means	45.1	48.8	53.0	60.0	66.9	74.4	82.6	82.1	71.0	63.2	52.6	45.4	62.1

SUMMER TEMPERATURES AT PARIS AND AT RENO, NEV.

By H. F. ALCIATORE, Section Director.

[Dated: Weather Bureau, Reno, Nev., May 26, 1915.]

In connection with Angot's method for classifying summers (Monthly Weather Review, Nov., 1914, **42**: 628–629) I here submit a tabulated statement of temperature excesses (on a basis of 30°C. or 86°F.), differences, and departures for Reno, Nev., and Paris, France. Angot has stated that his method gives results to a certain extent dependent upon the temperature selected for the lower or starting point. As the only Paris data at hand are those for summers compared on a basis of 30° C., I selected the same temperature for comparing Reno's summers. It is evident that a starting temperature of 86°F. (30°C.) is too low for Reno, the average excess for the summer being 177°F. as against 27°F. at Paris.

In a way, the starting temperature, if judiciously chosen, could be such as to give one a fairly good idea of what might be called the "discomfort units" of summer. For example, at Reno (and probably at 99 per cent of the regular Weather Bureau stations) a day on which the temperature exceeds 90°F. (32.2°C.), would be termed a warm day, while one with 87°F. (30.6°C.) would not.

TABLE 1.—*Reno and Paris summers compared.*

(Reno: Lat., 39° 32′ N.; long., 119° 49′ W.; elevation, 4,500 feet above sea level.)

[Sums of maximum temperatures exceeding 86°F.]

Year.	At Reno—						Sum, Reno.	Sum, Paris.	Difference, Paris–Reno.	Departures at—	
	Apr.	May.	June.	July.	Aug.	Sept.				Paris	Reno.
1888	2	.....	.....	46	84	26	158	9.0	−149.0	− 21.3	− 19
1889	.....	6	38	99	98	23	264	1.1	−262.9	− 29.2	87
1890	.....	.....	8	65	27	.....	100	7.7	− 92.3	− 22.6	− 77
1892	.....	.....	19	41	72	12	144	37.4	−106.6	7.1	− 33
1893	.....	.....	.....	60	51	.....	111	49.3	− 61.7	19.0	− 66
1897	.....	.....	3	41	64	.....	108	6.8	−101.2	− 23.5	− 69
1898	.....	.....	16	98	104	12	230	48.6	−181.4	18.3	53
1899	.....	.....	26	98	.....	15	139	53.1	− 85.9	22.8	− 38
1901	.....	.....	14	115	51	2	182	28.8	−153.2	− 1.5	5
1903	.....	1	14	15	54	16	100	12.4	− 87.6	− 7.9	− 77
1904	.....	.....	15	52	69	17	153	53.6	− 99.4	23.3	− 24
1905	.....	.....	2	147	68	7	224	10.1	−213.9	− 20.2	47
1906	.....	.....	3	173	100	.....	276	43.2	−232.8	12.9	99
1907	.....	.....	.....	40	40	8	88	8.5	− 79.5	− 21.8	− 89
1908	.....	.....	8	155	98	14	275	3.4	−271.6	− 26.9	98
1909	.....	.....	21	71	96	3	191	4.0	−187.0	− 26.3	14
1910	.....	30	28	156	114	3	331	.....	−331.0	− 30.3	154
1911	.....	.....	12	107	40	.....	159	178.7	19.7	148.4	− 18
1912	.....	.....	27	54	46	3	130	19.6	−110.4	− 11.7	− 47
Averages	0.1	4.1	13.4	85.9	67.2	8.5	177.0	30.3	−146.7	.....	.....

Months in which the temperature has not once reached 87° F. are indicated by leaders. All temperatures, differences, and departures are in Fahrenheit degrees. No signs appear before *plus* differences or departures. *Minus* differences indicate that Paris was cooler than Reno. Only years for which complete records for both places are available appear in the table. The values at bottom of table are the 19-year averages. The values for Paris are the Fahrenheit equivalents of the data in Table 2, p. 629, Monthly Weather Review, November, 1914.

Referring to the Reno-Paris table, the most noteworthy fact brought out is, that in 18 out of 19 years Reno's summers have been warmer than those of Paris. The exception was the summer of 1911, which, in Paris, was the hottest on record.

At Reno the greatest monthly excesses occur, as a rule, in July. The average seasonal excess is 177°, more than five times as large as that of Paris. For the 19 years covered by the records, the hottest summer was that of 1910, with an excess of 331°; the coolest, that of 1907, with an excess of only 88°. Eleven of the 19 summers were warmer than usual. No periodic alternation of warm and cool summers has been observable for periods of more than three years' duration.

That the summers of Paris are so very much cooler than those of Reno will probably be a surprise to the French residents of Reno, of whom there are a large number. Now, in Reno, intolerably hot days are unknown, probably because on those days when the temperature exceeds 90° F., the air is always exceedingly dry. To one who has lived in the Middle or Southern States for two or more years, Reno's summers are *imitation* summers, merely. Nobody ever suffers from the effects of the heat in Reno. On many evenings in summer light coats and wraps are worn on Reno's streets. Now, since the average seasonal excess (on a basis of 86°F. or 30°C.) is 30°F. at Paris, as against 177°F. at Reno, it follows that the average Paris summer must be cold. Perhaps this is one reason why thousands of Louisianians and other southerners are so fond of spending the summer season in the capital of France.

It seems to me that comparative summer-temperature tables prepared in the manner suggested by Angot for all the Weather Bureau stations in the United States which claim to be summer resorts should prove both interesting and valuable. It would be highly interesting, for instance, to compare the summers of Asheville, Lake Minnetonka, Colorado Springs, Reno, and San Francisco.

At first thought, it seemed to me that the Angot method would enable us to find a numerical expression for "discomfort degrees" in summer, but after looking into the subject more closely it occurred to me that without the humidity element of the climate, this could not be. To those who are familiar with the climates of San Francisco and Reno, it must be evident that a temperature of 86°F. and a relative humidity of 82 per cent stand for a greater number of discomfort units than do a temperature of 86°F. and relative humidity of 25 per cent. (The humidities cited are the mean 5 p. m. values for San Francisco and Reno, respectively, for July.) Indeed, the first would be a very warm, oppressive day, while the latter would be a comfortable and moderately warm one. I think that the Angot tables would reach their highest degree of usefulness and convenience if, in some manner, the relative humidity were made an integral part of such tables. If this were done in the case of Paris and Reno, perhaps the Paris summers would not turn out to be so cold as the Angot table *without humidities* seems to make them out. Why not use the mean relative humidity at the observation next following the occurrence of the daily maximum temperature? This, I believe, would be sufficiently accurate for practical purposes. Or, in order to avoid the integrating of temperatures and humidities, why not use the mean *wet-bulb* temperature at the observation next following the time of occurrence of the maximum temperatures? In other words, the "sensible temperature," so called.

The importance of humidity data in this connection may be understood by considering some of the climatic conditions that entered into the make-up of an usually warm day in Reno, namely, August 5, 1914. At 1 p. m., the thermometer stood at 98°F. (37°C.); and there was a 3-mile-an-hour breeze blowing from the southeast at the time. At the 5 p. m. observation following, or four hours later, the wet-bulb temperature was 62°F., and the relative humidity only 18 per cent. The sky was cloudless. These are typical warm-weather conditions, and the reader familiar with wet-bulb temperatures and relative humidity data will readily understand why intolerably hot, muggy weather and sunstrokes are unknown in Reno.

WEATHER AND RADIUM EMANATION AT MANILA, P. I.

During the year July, 1913, to July, 1914, J. R. Wright and O. F. Smith, of Manila, P. I., have continued their observations on the amount of radium emanation in the atmosphere of that city, with the object of determining more definitely to what extent the amount of radium emanation in the air is dependent on weather conditions. The details of the work are presented in the "Physical Review" for June, 1915, and we reprint below the general conclusions reached.[1]

Summary of results.

1. The variation of the amount of radium emanation in the atmosphere *at Manila* has been determined for a period of about 13 months. The annual and diurnal variation has been studied in connection with the principal meteorological factors. The effect of weather conditions on the rate at which radium emanation is exhaled from the surface of the ground has been investigated with the object of determining its connection with the emanation content of the atmosphere. The relation between the rate of exhalation and the radioactivity of soil gas at different depths has also been investigated.

2. The variation of the radium-emanation content of the atmosphere has been found to follow quite closely the variations in rainfall and wind movement. [See Table 1.] The ratio of the maximum to the minimum for the year was found to be approximately as 10 to 1. The mean of the monthly means gives for the radium equivalent of the emanation per cubic meter of air a value of 71.0×10^{-12} grams. The month of January shows the highest monthly mean for the radium-emanation content, the minimum value for the rainfall, and a low value for the total wind movement. The month of July gives the lowest monthly mean for the emanation content, the maximum value for the rainfall, and the highest total wind movement. Every other month of the year shows a very similar relation. No direct connection has been discovered between the emanation content and atmospheric pressure or humidity. The effect of the direction of the wind seems at best very indefinite.

TABLE 1.—*Annual variation of the radiation-emanation content at Manila.*

[Number in brackets in last column shows the number of observations entering into the monthly mean.]

Month.	Pressure (mean).	Humidity (mean).	Wind, total movement for month.	Rain (total).	Radium emanation per cubic meter expressed in its radium equivalent.
1913.	*Mm.*	*Per cent.*	*Km.*	*Mm.*	*Grams* $\times 10^{-12}$.
July	756.26	86.2	10,374.6	570.6	23.6 [3]
August	756.93	87.0	8,843.5	349.1	27.6 [3]
September	757.67	8[illegible].4	8,664.5	365.5	43.1 [4]
October	758.51	83.4	4,152.0	119.7	62.1 [3]
November	761.04	81.7	3,667.5	31.1	62.7 [2]
December	761.32	80.9	4,021.0	37.8	89.3 [3]
1914.					
January	763.24	76.2	4,925.5	3.5	117.1 [2]
February	762.26	73.8	5,255.5	7.3	108.3 [2]
March	760.77	68.6	6,344.0	6.1	108.6 [1]
April	760.17	70.8	5,921.0	53.4	68.9 [1]
May	758.42	72.6	6,137.5	84.0	83.7 [2]
June	757.62	81.7	6,714.0	367.9	59.0 [2]
July					19.2 [1]
Mean of monthly means					71.0

[1] **Wright, J. R., & Smith, O. F.** The variation with meteorological conditions of radium emanation in the atmosphere, in the soil gas, and in the air exhaled from the surface of the ground at Manila. Phys. rev., Lancaster, Pa., June, 1915, 5: 459-482.

3. A decided diurnal variation has been found to exist, the emanation content being considerably greater during the night than during the day. Observations for the interval from 11 p. m. to 5 a. m. gave a mean value 3.31 times greater than the mean value for the interval from 11 a. m. to 5 p. m. This variation has been found to be closely related to the variation in the total wind movement during the period, a high value of the wind movement corresponding to a low value of the emanation content.

4. The rate at which radium emanation is exhaled from the surface of the ground shows a decided decrease after periods of heavy rain. This decrease has been found in some cases to be almost 60 per cent of the rate of exhalation for fair weather.

5. The radium-emanation content of soil gas has been determined for depths of 30, 70, and 120 cm., respectively, and the variation with weather conditions studied. The variation of the radioactivity of the gas from the 30 cm. pipe was found to follow closely the variation in the emanation exhaled, a decrease in the exhalation resulting in a corresponding increase in the emanation content of the ground gas. The 70 cm. and 120 cm. pipes showed only slight variations with the weather conditions. The average value of the emanation content for the gas collected from the 120 cm. pipe was found to be 304.5×10^{-12} grams per liter, or over 4,000 times the mean value for atmospheric air. The mean value for the 30 cm. pipe was only about one-seventh that for the 120 cm. pipe.

METEOROLOGICAL PAPERS PRESENTED AT THE HAVRE MEETING OF THE FRENCH ASSOCIATION.

At the 43d session of the Association Française pour l'Avancement des Sciences, held at Havre in July, 1914, there were presented a number of interesting papers dealing with subjects of interest to the meteorologist. The following abstracts have been translated from the Comptes rendus of the 43d session, Paris, 1915, p. 101, ffg. — C. A., jr.

Reforestation and "occult" condensations.—An abundant and regular supply of water is the vital essential of inland navigation, of the "white coal" [waterpower] supply, and of agriculture. The "occult" condensations dew and white frost, are not recorded by the raingage but they supplement the rainfall with a quantity of water which is controlled and regulated in advance of its precipitation and which would be considerably increased by reforestation. For the quantity of frost (givre) coating a tree at the close of a clear winter night is much greater than the quantity that collected during the same night on a piece of naked ground whose area equals that of the projection of the tree. Reforestation, already serving as an element in the control of the water supply, may therefore be employed to increase the supply of water under man's control, and it is desirable to determine the extent to which reforestation can contribute.

After discussion, the section of the Association resolved that we should undertake studies designed to determine the degree to which reforestation can supplement the water supply by thus reinforcing the "occult" condensations, such as dew and frost.—*Paul Descombes.*

Weather forecasts by Guilbert's rules.—The author called attention to the circumstance that his rules for forecasting (Principes)[1] as published in 1891 have been designated by certain official meteorologists as being "as useless as possible" and "without either scientific or practical value of any kind." Experience alone can decide whether or no these criticisms are exaggerated.

Guilbert's method has now been applied in forecasting for a Parisian journal since October 1, 1912, with the result that the proportion of verifications has been 80 per cent. During the winter semester of 1913–14 this proportion rose to 86 per cent; while the proportion of verifications rose to 89 per cent for those predictions essentially peculiar to his method, viz, the changes in the barometric depressions resulting in their intensification, weakening, or disappearance.

The relation of cause to effect as established by the author between the force-direction of the wind and the consecutive variation in the barometric pressure has proved so exact that it has been possible in many of his forcasts to designate (1) the relative importance of the future barometric change, (2) its location, (3) its limits, and (4) even the name of the station where the barometric rise (hausse barométrique) will attain its maximum. Thus, among all the stations in France, for example, the author has been able to designate the occurrence of this maximum as now at Nantes, now at Nice, or Paris, or Charleville, or at Havre, etc.

This "new method" forecasts every meteorological phenomenon—rain and wind, temperature, fog, thunderstorms, etc.—simultaneously with its principal cause, the pressure change. The new method is, therefore, not merely practical and utilizable but also scientific, since every forecast is made according to principles and rules established on constant facts; moreover, the rules may be applied by every meteorologist. A method that during 21 months has permitted a daily forecast of atmospheric phenomena which meteorological science does not even attempt to foresee, must be regarded as a step in advance and ought to put an end to the existing empiricism of official meteorological forecasts.—*Gabriel Guilbert.*

Barograms and thermograms in relation to cosmical phenomena.—The study of nebulæ leads the author to the supposition that the combustion phenomena [in nebulæ] further the escape of gaseous masses which resemble the matter composing the stars, and that these masses become residual matter in interstellar space.

When comets approach the sun (i. e., approach their perihelion) they undergo quite irregular variations in form and brilliancy; they have been observed (Morehouse) to give off explosions and even to be destroyed (Biéla) by an explosion. All these phenomena are explicable only as due to the influence of an exterior gaseous medium. Therefore, he concludes that the interplanetary spaces of the solar nebulosity, as well as of the others, contain residual gases.

This concept seems to furnish an explanation of meteorological phenomena. While preparing for Le Temps (Paris) the daily temperature- and pressure-curves observed at the observatory Tour Saint-Jacques in Paris, there was noticed a certain parallelism between these simultaneous curves. This parallelism could be very simply explained by referring it to the rising and falling of that upper atmospheric stratum called the "stratosphere." It then becomes necessary to seek the general cause of atmospheric variations in the region above that stratum by ascribing them to the passage of independent gaseous masses that happen to come into contact [with the earth's atmosphere] and are influenced by the terrestrial rotation.

[1] See this REVIEW, May, 1907, 35: 210-212.—EDITOR.

The Bureau Central Météorologique very kindly placed at my disposal the files of its Bulletin, which contains a great mass of accurate material that is very suggestive of the hypothesis when systematically arranged according to the above ideas.—*Jean Meunier.*

Hertzian waves should be observed and continuously recorded.—In November, 1911, the Observatoire Saint-Louis on the Isle of Jersey (Channel Isles) began to maintain a continuous record of electromagnetic waves of atmospheric origin. The recording device, called a *meteorondograph* (*Fr.*, météorondegraphe), involves a specially designed galvanometer which serves as a vibrating relay (relais-trembleur), and the observations are directed more toward determining the intensity rather than the frequency of the waves.

Observations have now been maintained through two complete years, and they permit us to recognize the existence of a normal hertzian field which, in common with all other atmospheric phenomena, is subject to laws of very constant, regular diurnal and annual variations; but it is also subject in common with the terrestrial magnetic field to sudden disturbances of great violence directly related to local or neighboring thunderstorms.

A comparative study at Tortosa, Spain, of observations bearing on the frequency of such waves, has shown that the hertzian field exists there also and shows the same character and law of variation that it does at Jersey.—*Marc Dechevrens.*

Thunderstorm of June 15, 1914 at Paris.—A torrential rainfall accompanied this storm between $17^h\ 40^m$ and $18^h\ 04^m$, giving 41 mm. in 24 minutes; there resulted serious damages to the "Métropolitain" [the Paris Underground] as well as injuries to persons.

The peculiarities of the storm as recorded at the Bureau Central Météorologique were described. The barogram showed a "squall hook" [2] and the wind vane made a complete circuit in the direction NW.-W. [anticlockwise] which is explained by the peculiar form of the barogram. The barometer located at the summit of the Eiffel Tower [not far from the Bureau Central Météorologique] did not record any such sudden change: an interesting relation, since it is in accord with the hypothesis which explains the sudden rise in pressure [causing the "squall hook"] as a dynamic effect produced by the descent of the air in the "squall zone".[3]—

THE GREEN FLASH AT SUNSET.[1]

By ALFRED W. PORTER.

[Dated: University College, London, Feb. 7, 1915.]

So much has been written about the green-ray at sunset that I am somewhat diffident about adding anything. But as I find myself unable to accept the orthodox explanation of the phenomenon usually seen, I write this note. This phenomenon, as seen by me on several occasions during the last summer on my way to Australia, always consisted in the last segment of the red sun before disappearance becoming a bright green (without any transition through intermediate tints); this green was, as nearly as could be judged, the complementary to the red of the sun itself. On one occasion I shut my eyes immediately the green tint appeared and it *remained visible.* There could be no doubt that what I saw was the purely subjective afterimage of the disappearing segment of the sun.

Of course if this is so it should be easy to set up a laboratory experiment to imitate the natural phenomenon; and on returning [to London] I asked Mr. E. Talbot Paris, research student in the Physical Department of this University, to arrange an experiment in illustration. An eccentric hole was made in a disk mounted on an axle. Red glass or gelatin film was fixed over the hole, and a bright light placed behind illuminated the film and produced thereby a miniature sun, which by slow rotation could be made to "set" behind an interposed card. At the exact instant of setting the artificial sun exhibited an exact reproduction of the phenomenon of the green ray. It was easily possible in this way to obtain a red ray using a green sun, or a blue ray with a yellow sun, and so on.

It is easy to give the rationale of the effect. The positive light gradually diminishes as the artificial sun passes below the horizon; and it only requires a little adjustment of the rate of disappearance in order that the negative afterimage excited at a previous instant when the segment was brighter shall overpower the simultaneous weaker positive image of the remaining segment itself.

It would not be fair for me to dogmatize and assert that this is the only phenomenon which comes under the head of the green ray. But it is certainly the only one which I succeeded in seeing; and *it must always be present even on the possible rarer occasions when color changes arising from dispersion are also evident.* It is certainly also what many others saw. At the same time it must also be added that the phenomenon as observed by different persons, even on the same night, was so variously described as to lead one to suppose that the subjective element is sometimes present to even a greater degree than is implied in the above note.

[The interested reader will find the green flash discussed briefly, as a phenomenon of refraction, by H. Schering in this REVIEW, September, 1905, **33**:408.—EDITOR.]

PERNTER AND EXNER ON THE GREEN FLASH.[1]

These authors describe the green-ray as having the color of the emerald, or about wave-length $530\mu\mu$, and state that sometimes it has been reported to be of blue color. Of recent years it has been reported much more frequently than during the years previous to 1900, probably because more attention has been paid to this phenomenon. The "ray" or "flash" lasts but a few seconds, sometimes only a fraction of a second, and seems to be more frequently observed within than outside the Tropics.—C. A., jr.

The first explanations of the green ray referred it to the phenomena of optical atmospheric refraction which would cause the green, the blue, and the violet rays to be the last ones reaching the observer from the sun as it set below the horizon. Atmospheric extinction tends to blot out the most highly refracted waves—i. e., the blue and the violet—so that there remains a color mixture consisting of the more refrangible portion of the spectrum, viz, pre-

[1] *Reprinted from* Nature (London), Feb. 18, 1915, **94**: 672.
[2] *See* Loisel, J. Squalls and thunderstorms. MONTHLY WEATHER REVIEW, June, 1909, **37**: 239.
[3] Loisel, op. cit., p. 237.

[1] Pernter & Exner. Meteorologische Optik: IV. Abschnitt (Exner), Wien, 1910, p. 798-799.

cisely that green color. M. Prosper Henry points out that computation calls for a duration of about one second for the green ray if this is the correct explanation of the same.

Later Julius endeavored to explain the green ray as a phenomenon of anomalous dispersion. He also computed the duration which the green flamelet (as the phenomenon is also sometimes called) might have according to the foregoing explanation and found, in contrast to Henry, the value about one-tenth second. Therefore, ordinary optical refraction would not be adequate to explain the phenomenon and he had resort to anomalous refraction. By reason of this anomalous feature the wave lengths lying close to those of the absorption bands of a gas suffer an abnormally large refraction in that gas. According to Julius, oxygen and nitrogen absorb the green-blue wave lengths, so that anomalous refraction causes the bright-green rays to be the last ones reaching the eye from the uppermost edge of the sinking sun.

It is still a question whether the certainly slight absorption of pure atmospheric air is adequate to explain the green ray.

Analogy with green and blue suns, suggests that it may be simpler to explain the phenomenon by the selective absorption of water vapor. The green ray is most frequently observed at sea level over the sea; and the lowest atmospheric strata, particularly those over the sea, contain by far the greatest amount of water vapor. One may therefore assume that the strip of the setting sun's disk lying closest to the horizon emits rays which could be colored green by reason of the absorption of the water vapor; particularly true since the observed cases are usually during very clear atmospheric conditions when there is but very slight extinction or absorption of the blue rays. While a large proportion of the sun's disk is visible the eye is so blinded that it can not distinguish the shade of the lowest segment, therefore the green appears only in the last seconds when the eye is no longer affected by other light.

It is apparent that we have not yet found the final explanation of the green ray.

NOTES.

Dr. William Napier Shaw, director of the Meteorological Office, London, and known to most of us as the author of Forecasting Weather, was knighted by the King of England on June 3, 1915.

We regret to announce that Aksel S. Steen, director of the Norwegian Meteorological Institute, died on May 10, 1915. He had been director of the institute since September 1, 1913, when he succeeded Prof. Henryk Mohn.

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR JUNE, 1915.

By ALFRED J. HENRY, Professor of Meteorology.

[Dated: U. S. Weather Bureau, Washington, D. C., July 15, 1915.]

June, from a forecasting point of view, is one of the most interesting months of the year, and June, 1915, proved no exception to the rule. It provided a number of features that marked it as exceptional, viz, the relatively large number of cyclones and anticyclones (lows and highs) that prevailed. Fifteen lows and 12 highs were sufficiently well defined to be plotted on Charts II and III, respectively. These totals are practically the same as are usually experienced in a winter or spring month, and the movement at times was as rapid and definite as that of winter. It was a case of forecasting in a summer month with winter movement of the highs and lows.

Highs.—As may be seen from Chart II, nearly all of the highs were first observed along the Washington and Oregon coasts or in the Canadian Northwest, the single exception being No. II, which first appeared over the Gulf of St. Lawrence with barometer level of 30.38 inches. It maintained its position over the Canadian maritime provinces about two days. Highs first appearing as this one did belong to a small group that is observed mostly in the spring season. These highs are associated with a marked fall in temperature over the North Atlantic States, and occasionally the fall in temperature extends into the South Atlantic States. The appearance of a high in the region mentioned so late in the season is unusual. High No. VI has a remarkable track, having passed from the Pacific to the Atlantic in a little more than three days, and being twice reenforced on its way, first in the upper lake region when the barometer level increased to 30.30 inches, and again over Maine and Nova Scotia, when pressure reached the unusually high level for the summer of 30.40 inches.

Lows.—The large number of lows plotted in June was made up of two groups, viz, primaries having their apparent origin in Alberta; and secondaries, the latter developing mostly to the west of the Continental Divide in Wyoming, Colorado, Utah, and Arizona—see Chart III.

The development of lows in the Southwest and their subsequent movement to the Northeast is probably that feature which determines the character of the weather of the month in the Great Plains States. If lows develop and their movement is as indicated, rains for the needs of agriculture will be plentiful; indeed, if the movement is any way persistent or recurrent, far too much water falls and destructive floods are caused. Sometimes, as in 1903, the movement begins in the latter part of May, and much rain falls by reason of the slow drift of one or more barometric depressions. In 1908, another wet June, but three depressions contributed the surplus water which fell upon the Plains States in that month. During the current month the number of Southwest lows was not only large, but they succeeded one another quickly. The resulting floods are described in Section IV.

Warnings of high winds.—Warnings were issued in connection with low No. I, when it was off the coast of the South Atlantic States, June 2-3; high winds continued for several days off the Virginia Capes. An easterly gale of 64 miles per hour was registered at Cape Henry on June 3.

High shifting winds of short duration prevailed in the lake region on the 18th in connection with low No. X. Other high winds that occurred were due to thunderstorms.

SECTION IV.—RIVERS AND FLOODS.

THE FLOODS OF MAY AND JUNE, 1915, IN THE MISSOURI VALLEY.

By ALFRED J. HENRY, Professor of Meteorology.

[Dated: Weather Bureau, Washington, D. C., July 30, 1915.]

A period of wet weather of far-reaching effect began in the middle Missouri Valley about May 18, 1915. Showers, many of them quite heavy, were almost of daily occurrence from the 18th to the 28th. The weather for a month or more previous to the beginning of the rains had been deficient in rainfall and the ground was thoroughly dry.

The tributaries of the Kansas River did not overflow their banks in spite of the continuous rains of May, but they became almost bank full andthe soil throughout the watershed was so thoroughly soaked that the run-off was greatly augmented and the probabilities of flood stages in case of further rains was greatly increased. The rains of May 26-27-28 brought about the expected, and the Missouri River at Kansas City passed above the flood stage (22 feet) on May 28 and continued above until the end of the month. On June 12, due to additional rains, it passed above the flood stage and again on June 18, remaining above until the 28th. At the close of the month the river had fallen to 20.7 feet, but additional rains caused it to be in flood the greater part of July, and at this writing, July 30, it is 1 foot above the flood stage.

Between Kansas City and its mouth the Missouri River was above flood stage for the dates set forth in the table below.

TABLE 1.—*Flood stages in Missouri River, June, 1915.*

Missouri River at—	Flood stage.	Above flood stage.		Crest.	
		From—	To—	Stage.	Date.
	Feet.			*Feet.*	
Kansas City, Mo	22.0	12th	13th	23.7	12th.
		18th	28th	27.0	21st.
Waverly, Mo	22.0	13th	13th	22.3	13th.
		19th	28th	24.7	22d.
Boonville, Mo	21.0	1st	6th	24.6	1st.
		13th	15th	21.5	14th.
		21st	28th	22.5	23d.
Hermann, Mo	21.0	1st	7th	25.9	2d.
		15th	16th	21.2	15th.
		21st	30th	23.5	25th.

TABLE 2.—*Flood stages in Kansas River and tributaries for June, 1915.*

River.	Station.	Flood stage.	Above flood stage.		Crest	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Solomon	Beloit, Kans	18.0	5th	8th	32.3	6th.
			18th	22d	32.4	10th.
Smoky Hill	Lindsborg, Kans	20.0			18.1	26th.
Republican	Clay Center, Kans	18.0	18th	25th	26.2	21st.
Big Blue	Beatrice, Nebr	16.0			[illegible].8	8th.
Kansas	Wamego, Kans	18.0	20th	21st	20.3	20th.
Do	Topeka, Kans	21.0	11th	12th	22.4	11th.
			19th	21st	23.8	20th.
			24th	25th	21.9	24th.

The Mississippi River.—The effect of the June, 1915, rains over the watershed of the middle Mississippi combined with the effect of the Missouri, was not sufficient to produce more than a moderate flood between Quincy, Ill., and Cape Girardeau, Mo., as may be seen from Table 3, following.

TABLE 3.—*Flood in the Mississippi, June, 1915.*

Mississippi River at—	Flood stage.	Above flood stage.		Crest.	
		From—	To—	Stage.	Date.
	Feet.			*Feet.*	
Quincy, Ill	14.0	3d	12th	15.2	8
Hannibal, Mo	13.0	1st	13th	15.4	8
Grafton, Ill	18.0	1st	16th	20.2	4
		22d	29th	20.3	24
St. Louis, Mo	30.0	1st	6th	31.3	3
		22d	30th	31.6	24
Cape Girardeau, Mo	30.0	1st	19th	33.7	6
		22d	30th	33.0	30
Arkansas City, Ark	42.0	9th	30th	44.9	16

Floods elsewhere than in Missouri and Mississippi Rivers.—Flood stages were reached at one or more places on the rivers as shown in the table below:

TABLE 4.—*Flood stages elsewhere in the United States, June 1915.*

Rivers and stations.	Flood stage.	Crest.	
		Stage.	Date.
North Canadian:	*Feet.*	*Feet.*	
Reno Junction, Okla	8.0	9.1	10
Canton, Okla	3.0	6.0	7
Neosho:			
Fort Gibson, Okla	22.0	23.0	1 and 29
Iola, Kans	10.0	11.0	12
Oswego, Kans	20.0	21.7	1 and 16
Black:			
Black Rock, Ark	14.0	14.3	3
White:			
Georgetown, Ark	22.0	22.1	4
Arkansas:			
Fort Smith, Ark	22.0	25.7	1
Dardanelle, Ark	20.0	26.6	1
Little Rock, Ark	23.0	25.4	1
Pine Bluff, Ark	25.0	26.9	2
Red:			
Denison, Tex	22.0	24.5	9
Arthur City, Tex	27.0	33.7	10
Fulton, Ark	28.0	28.6	1
		30.2	15
Sulphur:			
Springbank, Ark	29.0	29.1	19
Rio Grande:			
San Marcial, N. Mex	11.0	13.8	5
El Paso, Tex	15.0	15.7	1
		16.1	9
		15.3	30
Trinity:			
Bridgeport, Tex	20.0	28.9	8
Fort Worth, Tex	20.0	37.6	10
Dallas, Tex	25.0	37.7	12
Brazos:			
Brazos, Tex	12.0	20.0	8
Kopperl, Tex	21.0	22.0	9
Waco, Tex	22.0	25.7	9
Grand:			
State Bridge, Colo	9.0	9.5	2
Neuse:			
Neuse, N. C	12.0	17.6	5
Smithfield, N. C	13.0	16.8	7
Cape Fear:			
Fayetteville, N. C	35.0	40.2	4
Elizabethtown, N. C	20.0	32.0	5
Great Pee Dee:			
Cheraw, S. C	27.0	30.0	4
Catawba:			
Catawba, S. C	11.0	11.0	2
Wateree:			
Camden, S. C	24.0	25.8	3
Santee:			
Rimini, S. C	12.0	13.5	6
Ferguson, S. C	12.0	13.3	8
Stanton:			
Randolph, Va	21.0	22.2	3
Potomac:			
Cumberland, Md	8.0	10.3	3
Kings:			
Piedra, Cal	12.0	13.3	1
San Joaquin:			
Lathrop, Cal	17.0	17.1	4 and 12

Meteorological conditions associated with the rains.

Whatever may be the ultimate cause or causes of long-continued rains over the Plains States—particularly over Kansas and Nebraska—the immediate visible cause, referring to surface conditions only, is the immediate pressure distribution. This may be roughly characterized as a development of lows over the Middle Plateau region generally west of the Continental Divide, and a movement of such lows thence southeastward to the Texas Panhandle, thence northeastward to the Lake region with their paths converging over northwestern Missouri or northeastern Kansas. If the Lake region is occupied by areas of high pressure, which in the spring of the year often appear to exert a retarding influence on lows advancing from the southwest, the conditions for heavy and often continuous rains in the Missouri Valley are ideal. The great flood of May, 1903, when the rainfall for the month was greater than for the corresponding month of 1915, was due to the meanderings of a single low during the 10 days from May 21 to May 31. (See MONTHLY WEATHER REVIEW, May, 1903, Charts XI-XXII.)

The heavy rains of May, 1892, when the average for eastern Kansas was 8.72 inches as against 8.59 inches for May, 1915, are clearly traceable to the fact that five lows crossed eastern Kansas in that month. (See MONTHLY WEATHER REVIEW, May, 1892, Chart I.)

In May of the current year two lows, moving as shown on Chart IA of this issue of the REVIEW, were the visible cause of the heavy rains of the last ten days of May. On Chart IA have been also plotted the tracks of the two lows in June, and also (in red) the tracks of the highs that were associated with them, thus assembling on one chart the paths of the highs and lows chiefly concerned with the rainstorms. The general principles illustrated by the movements shown on Chart IA are familiar to forecasters and others, and have been stated in the beginning of this note. In connection with the May lows (17th and 25th), it will be seen that both of them failed to reach the Lake regions, the first one dissipated over Iowa and the second travelled far to the south, while No. III (June 11) moved quite rapidly northeastward; it gave but a short period of rain. The low of June 16, No. IV, also moved with considerable speed, apparently because its advance was not obstructed by a high. One of the highs charted apparently came from the region of Hudson Bay. It is known by experience that highs from that or even other regions of the north or northwest in the late spring or early summer often lodge over the Great Lakes and sometimes exert a strong retarding influence upon the movement of lows that may threaten to advance from the west or southwest.

In the last 29 years there have been three occasions in the month of May when the atmospheric conditions tended toward heavy and continued precipitation in the middle Missouri Valley, or about one year in ten. The same rule holds for June, but not for April or July.

Forecasting of floods.

In general, the floods enumerated in the foregoing were successfully forecast and a very material public service was thus rendered, especially in the densely populated suburbs of Kansas City along the river bottoms; also in the rich and prosperous farming communities along the Missouri River. The forecasts for the Kansas City district were made by P. Connor, of the Kansas City Station; those for the Missouri, east of Kansas City, by Montrose W. Hayes, of the St. Louis station.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

LOSS BY FLOODS IN KANSAS RIVER AND TRIBUTARIES, JUNE, 1915.

By P. CONNOR, Local Forecaster.

[Local office, Weather Bureau, Kansas City, Kans.]

The northern half of Kansas suffered very heavy losses during June, due to the occurrence of severe local storms with exasperating frequency, which were attended by torrential rains, causing the smaller streams to rise with extraordinary suddenness, overflowing contiguous land, carrying away bridges, and later producing floods in the larger rivers.

Aside from the small streams which immediately responded to the local downpours, the first river to overflow its banks was the Solomon, which rose from 2.6 feet on the 3d to 32.3 feet in early morning of the 6th at Beloit, Kans., breaking the high water record by 1.1 feet. The rainfall which produced this flood fell in places remote from reporting stations, so that the rapidly rising river at Beloit was the first intimation. Warnings were promptly telegraphed to Minneapolis, Kans., and Solomon City on the 5th, and the slow movement of the crest in that river afforded time for protection of property. The river subsided to normal by the 10th.

The territory overflowed in Mitchell County was estimated at from 50 to 60 square miles with an added 20 miles due to overflow of creeks, approximately 48,000 acres in all, with damage close to one million dollars. From Mitchell County to Solomon City the damage has been estimated at $350,000.

A recurrence of local storms on the 17th, giving 5.78 inches of rain at Beloit from 8 a. m. to 5 p. m., caused a rise in the river at that place from 4.3 feet at 7 a. m. of the 17th to 23.4 feet at 7 a. m. of the 18th and to 32.4 feet, or 1.2 feet above high water mark, at 6 p. m. on the 19th, remaining out of its banks until afternoon of the 22d.

Warnings were telegraphed Beloit, Delphos, Minneapolis, Bennington, and Solomon City on the 17th advising of a second overflow of the valley. The same area was inundated by the second flood, but there was little to prey upon. It only made the damage more complete and delayed reclamation and farm operations.

Raines from 4½ to 6 and 8 inches on the 17th and 19th at and above Concordia caused the greatest flood known in the Republican Valley from Superior, Nebr., to Junction City, Kans., where the Republican joins the Smoky Hill to form the Kansas River. Warnings of this flood were telegraphed on the 17th to towns from Junction City to Concordia, and again on the 20th Clay Center and Junction City were advised that a pronounced flood was imminent.

The area inundated was 2 to 6 miles wide from Superior to Junction City. At Clay Center the maximum stage was 26.2 feet at 11 a. m. 21st, the highest previous water being 24.8 feet in 1903. There was no gage at Concordia, the river having separated itself from the city in 1903 by at least a mile, but the observer, Mr. John W. Byram, writes: "The crest of the flood passed in night of the 20th. The district under water was the richest and most fertile in this section of the country, consisting of vast fields of

rapidly ripening wheat, growing corn and alfalfa, all of which were practically destroyed. The swift running waters cut new channels, washed the surface of the land away in places, and covered thousands of acres with a heavy deposit of sand."

The damage to agricultural interests in this county, growing crops, land and improvements considered, will approximate $1,500,000. Many small bridges were badly damaged. The Missouri Pacific Railroad was damaged about $50,000. The Burlington and Union Pacific had not succeeded in restoring communication with Concordia July 3. No lives lost in this county, but boats were constantly employed from 2 a. m. to 6 p. m., Sunday, 20th, rescuing persons living in the flooded area.

Below Cloud County the damage was about $1,500,000. The river cut new channels in several places. At Clay Center it broke through the dike and cut a new channel through a soft, spongy bottom which, if permanent, would necessitate a new bridge at a cost of $60,000 and would render valueless a concrete dam that cost about $50,000. But it is believed that a new dike will be built, compelling the river to return to its old channel, a more economical proposition with a more enduring prospect than attempting to bridge a river which will inevitably make new channels with each succeeding flood.

At Junction City the water was about 4 feet in depth over the railroad tracks. The flood carried out two Government bridges and one county bridge, and twisted the electric bridge several degrees out of alinement, the damages to bridges amounting to $40,000.

The Big Blue at Blue Rapids rose from 8.7 feet on the 17th to 26.5 feet on the morning of the 18th, 5.5 feet above flood stage, causing overflow and damaging crops in the immediate bottoms from Blue Rapids to Manhattan. There was no loss of stock or bridges. The damage in the entire valley did not much exceed $500,000.

From Solomon City to Topeka (almost equally divided between the Smoky Hill and Kansas Rivers) only slight overflow occurred (except locally at Junction City), with a consequent loss of about 15 per cent of the growing crops, amounting to about $350,000.

Advisory warnings were frequently sent to the river observers at Abilene and Wamego and to the corn and wheat observers at Manhattan. The postmasters at Solomon City and Junction have stated that the telegrams from this office were conspicuously posted, were very valuable, and greatly appreciated. The river observer at Clay Center writes that the information telegraphed from this office enabled the people to take measures to protect their property and stock.

The damage at Topeka was slight.

East of Topeka a series of freshets occurred between May 18 and July 3. From May 18 to 28, inclusive, more rain fell within a radius of 60 to 70 miles of Kansas City than during the entire month of May, 1903, the year of the great flood. Heavy rains on May 26, 27, and 28 caused all the smaller streams to overflow, doing much damage to crops on adjacent land, carrying away bridges, etc. The Kansas River bottoms were overflowed in many places for a distance of 30 miles west of Kansas City. Local downpours formed ponds and lakes in depressions, and much damage resulted to corn, potato, and alfalfa crops. In fact, a considerable portion of the bottoms was not free from water from the latter part of May to the first week in July, and even then several weeks without rain were required to dry up the numerous ponds.

The damage to potato, alfalfa, corn, and trucking crops in the Kansas Valley east of Topeka is estimated between $750, 000 and $1,000,000.

Although the heavy rains occurred simultaneously over the northern tributaries, the flood waters did not synchronize in the main artery. This was owing partly to the meandering courses of the streams, some of them bordered by shrubbery which, with overflowed wheat fields, retarded movement and smoothed out the crests. In addition, the maximum effect of the nearest tributary passed in the Kansas River before the next arrived, so that the Kansas Valley was spared a great flood.

The floods of 1903 and 1908 left an undesirable legacy to the farmers along the Kansas River between Topeka and Kansas City. The swift-moving currents in those floods, instead of following the channel, took a more or less direct course, cutting off curves, and in so doing, scoured out slight depressions of considerable width. Now, it happens that before the water is as high as the bank crests it enters the bottoms on the west approach of each curve, and the consequence is that water covers a much larger area and remains on the bottoms much longer than formerly. This is particularly noticeable at Linwood, Eudora, Loring, Lenape, and Holiday.

Recapitulation of flood damages on the Kansas River, June, 1915.

Solomon Valley	$1, 350, 000
Republican Valley	3, 000, 000
Big Blue Valley	500, 000
Smoky Hill and western portion of Kansas	350, 000
Kansas, east of Topeka	750, 000
Total	5, 950, 000

Estimate of highway engineers of damage to bridges, large and small, in the various counties in the Kansas River watershed, furnished Governor Capper of Kansas:

Damages to bridges in the Kansas River watershed.

Republic	$100, 000	Shawnee	$30, 000
Cloud	150, 000	Jefferson	75, 000
Clay	150, 000	Douglas	20, 000
Geary	125, 000	Leavenworth	50, 000
Riley	50, 000	Marshall	75, 000
Wabaunsee	20, 000	Ottawa	10, 000
Washington	25, 000		
Mitchell	25, 000	Total	1, 005, 000
Pottawatomie	100, 000		

The damage along the Missouri, Kansas City to Lexington, to crops was about $1,500,000. The damage to bridges and highways in the counties bordering the Missouri between St. Joseph and Lexington was $161,500.

MEAN LAKE LEVELS DURING JUNE, 1915.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., July 6, 1915.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during June, 1915:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	601.95	579.78	571.86	245.12
Above or below—				
Mean stage of May, 1915	+0.30	+0.14	+0.17	−0.03
Mean stage of June, 1914	−0.51	−0.82	−1.17	−1.79
Average stage for June, last 10 years	−0.32	−1.20	−1.11	−1.92
Highest recorded June stage	−1.48	−3.82	−2.66	−3.51
Lowest recorded June stage	+0.71	−0.12	+0.29	+0.23
Probable change during July, 1915	+0.2	+0.1	−0.1	−0.1

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL ABBREVIATIONS USED IN THE INSTRUMENTAL REPORTS.

CHARACTER OF THE EARTHQUAKE.

I = noticeable.
II = conspicuous.
III = strong.
d = (terræ motus domesticus) = local earthquake (sensible or felt).
v = (terræ motus vicinus) = nearby earthquake (within 1000 km.).
r = (terræ motus remotus) = distant earthquake (1000 to 5000 km. distant).
u = (terræ motus ultimus) = very distant earthquake (beyond 5000 km.).

Examples.—I_d indicates a local earthquake of small intensity but sensible to individuals.

III_r indicates a distant earthquake whose record shows motions of considerable amplitude.

PHASES.

P = (undæ primæ) = first preliminary tremors.
PRn = P waves reflected n times at the earth's surface.
S = (undæ secundæ) = second preliminary tremors.
SRn = S waves reflected n times at the earth's surface.
PS = transformed waves; longitudinal (P) to transversal (S) or vice versa.
L = (undæ longæ) = long waves in the principal portion.
M = (undæ maximæ) = greatest motion in the principal portion.
C = (coda) = trailers.
F = (finis) = end of sensible disturbance.

NATURE OF THE MOTION.

i = (impetus) = abrupt beginning.
e = (emersio) = gradual appearance.
T = period = twice the time of oscillation.
A = amplitude of the earth's movement, reckoned from the zero line.

E or N attached to a symbol signifies the E–W and N–S component, respectively, thus:

$$\left.\begin{array}{l}A_E \text{ is the E–W component of A} \\ A_N \text{ is the N–S component of A}\end{array}\right\}\text{: measured in microns } (\mu)\ \frac{1}{1000}\text{ mm.}$$

INSTRUMENTAL CONSTANTS.

T_0 = period of the instrument.
V = magnification of the instrument.
ϵ = damping coefficient.

SEISMOLOGICAL REPORTS FOR JUNE, 1915.

By WILLIAM J. HUMPHREYS, Professor in charge of Seismological Investigations.

[Dated, Washington, D. C., July 29, 1915.]

TABLE 1.—*Noninstrumental earthquake reports, June, 1915.*

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		ARIZONA.								
	H. m.		° ′	° ′			*M. s.*			
23	4 00	Tucson	32 15	110 50	2	1			Disturbance in southern California.	C. E. Gassick.
	4 00	Wickenburg	33 56	112 44	3	1				W. J. Haswell.
	4 00	Yuma	32 45	114 36	7	1	2	Rumbling		C. J. Wood.
	4 00	Yuma	32 45	114 36	6	1	5		Slight damage	E. E. Roddis.
23	4 56	Parker	34 06	114 13	5	3	3	Rattling		F. R. Macpherson.
	4 56	Wickenburg	33 56	112 44	5		4		Shook buildings	W. J. Haswell.
	4 56	Yuma	32 45	114 36	7	1	4			C. J. Wood.
	4 56	Yuma	32 45	114 36	6	1	5			U. S. Weather Bureau.
27	8 30	Mesa	33 24	111 50	2	6	6			E. B. Hill.
		CALIFORNIA.								
4	21 10	Shively	40 25	123 56	5	3	1			Frank Essig.
6	17 51	Coyote	37 14	121 44			3			Chas. Fletcher.
	17 51	Oakland	37 47	122 15	4	1	2			Chas. Burckhalter.
	17 51	Oakland	37 47	122 15	4	1	2	Faint		Mrs. O. Whittaker.
	17 51	San Francisco	37 48	122 26	4	1				U. S. Weather Bureau.
15	20 55	Chester	33 53	117 38	2	2				G. W. Olsen.
17	16 13	San Jose	37 15	121 46	4		1			Prof. Louis Kroeck.
18	15 05	Avalon	33 27	118 22	5	1	1			T. S. Manning.
	15 05	Los Angeles	34 03	118 15	4	1				Mrs. J. J. Walsh.
	15 05	San Pedro	33 45	118 14	4	3			Rattled windows	Mr. Walters.
	15 05	Santa Monica	34 00	118 30	5	1	5			F. E. Hill.
19	15 15	Avalon	33 27	118 22	2	1	1			T. S. Manning.

TABLE 1.—*Noninstrumental earthquake reports, June, 1915*—Concluded.

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		CALIFORNIA—contd.								
	H. m.		° ′	° ′			*M. s.*			
23	4 00	Barrett Dam	32 43	116 46	5	1				Mrs. L. P. Beidleman.
	4 00	Beaumont	33 55	117 00	3	2	1			Beaumont Co.
	4 00	Bonita	32 40	117 03	4	1	5			R. B. Dilley.
	4 00	Blythe	33 35	114 38	2	2	1 00			C. L. Suits.
	4 00	Brawley	32 59	115 40	8	1	1 00	Rumbling	Walls cracked	M. D. Witter.
	4 00	El Cajon	32 48	116 58	4	1	30			H. H. Kessler.
	4 00	Indio	33 43	116 12	5	1	30			Bruce Drummond.
	4 00	Indio	33 43	116 12	6	1				F. N. Johnson.
	4 00	Julian	33 05	116 37	3	1	5	Rattling		J. H. L. Vogt.
	4 00	Los Angeles	34 03	118 15	2	1				U. S. Weather Bureau.
	4 00	Nellie	33 22	116 52	3	2	6	Faint		N. H. Hargrave.
	4 00	Oak Grove	33 26	116 51	5	2	24			J. B. Simmons.
	4 00	Sterling	32 49	114 50	4	1	10	Rumbling		J. G. Castleberry.
23	4 56	Barrett Dam	32 43	116 46	5	1	10			Mrs. L. P. Beidleman.
	4 56	Blythe	33 35	114 38	2	1	1			C. L. Suits.
	4 56	Bonita	32 40	117 03	4	1	5			R. B. Dilley.
	4 56	Brawley	32 50	115 40	8	1	1 00	Rumbling	Walls cracked	M. D. Witter.
	4 56	El Cajon	32 48	116 58	4	2	30			H. H. Kessler.
	4 56	Indio	33 43	116 12	4	2				Bruce Drummond.
	4 56	Julian	33 05	116 17	3	1	35	Rattling		J. H. L. Vogt.
	4 56	Los Angeles	34 03	118 15	3					U. S. Weather Bureau.
	4 56	Nellie	33 22	116 52	3	2	6			N. H. Hargrave.
	4 56	Oak Grove	33 26	116 51	5	1	12			J. B. Simmons.
	4 56	Sterling	32 49	114 50	5	1	10	Rumbling		J. G. Castleberry.
	4 56	Redlands	34 04	117 12	2	1		Faint		P. W. Moore.
		NEVADA.								
28	6 18	Thorne	38 36	118 38	3	1				A. D. Radcliffe.
	6 18	Yerrington	38 58	119 10	4	2	10	Faint		A. E. Ricksecker.
		PORTO RICO.								
29	0 30	Vieques	18 09	65 27	3	1	5	Rumbling		H. W. Pease.

TABLE 2.—*Instrumental seismological reports, June, 1915.*

Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.

Alaska. **Sitka. Magnetic Observatory,** U. S. Coast and Geodetic Survey. J. W. Green.

Lat., 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kilograms.

Instrumental constants: E: V 10, T_0 17.4; N: V 10, T_0 15.6

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		eP_N	14 53 34					
		S_N	14 58 04					
		L	15 05 50	19				
		M	15 07 40	12	950	100		
		C	15 12 00	13				
		F	15 36 00					
6		eP_E	21 43 22	4				No principal portion on E-W.
		S_E	21 52 52	8				
		S_N	21 53 02					
		L_N	22 00 02	20				
		M	22 01 25	25		20		
		F	22 47 00					
23		eL	4 15 00	10				Only a few waves of small amplitude.
		C	4 20 00		10			
23		L	5 12 06	8				
		M	5 12 42		10	10		
		C	5 17 00					

Arizona. **Tucson. Magnetic Observatory,** U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat., 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants: E: V 10, T_0 16; N: V 10, T_0 19.6

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		eP_E	15 03 09	9				
		eP_N	15 03 49	9				
		L	15 15 49	12				
		M_E	15 18 08	17	120			
		M_N	15 22 42	14		80		
		C	15 25 00	14				
		F	15 50 00	10				
6		P	21 40 00	7				
		S	21 48 32	8				
		L	21 56 17	33				
		M	21 49 31	10	50	50		
		M_E	22 00 12	20	30			
		M_N	22 09 28	24		20		
		C_N	22 11 00	20				
		F_N	22 35 00	10				
23		P	3 59 46	4				
		L	4 00 50	5				
		M	4 01 30	6	300	680		
		C	4 02 00	4				
		F	4 32 00	4				
23		P	4 56 33	3				
		L	4 57 26	3				
		M	4 57 36	4	510	300		
		C	4 59 06	4				
		F	5 25 04	4				

TABLE 2.—*Instrumental seismological reports, June, 1915*—Continued.

California. **Point Loma. Raja Yoga Academy.** F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two component, C. D. West seismoscope.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
June 23	I_d ...	....	8 02 00	....	....	....	....	
		M	8 58 00	....	1,140*	1,020*	....	

*Amplitude on instrument.

Colorado. **Denver. Sacred Heart College.** A. W. Forstall, S. J.

Lat., 39° 40′ 36″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters.

Instrument: Wiechert 80 kg., astatic, horizontal pendulum.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
June 3	......	....	7 57 00	....	....	....	....	Very small waves on E-W. Thickening of pen marks on N-S.
			8 03 00	....	....	....	....	
5	......	....	3 30 00	....	....	....	....	Very small but distinct wavelets on N-S.
6	......	L_E	21 48 00	....	....	....	....	Just visible on E-W; very broken and irregular on N-S.
		M_E	21 49 00	....	....	....	....	
		F	21 52 00	....	....	....	....	
23	......	L_N	4 03 00	6	....	....	....	Earthquake in Imperial Valley, Cal.
		L_E	4 03 00	....	....	....	....	
		M_N	4 03 50	6	....	62	....	Preliminary phases very doubtful.
		C_N	4 05 00	4-5	....	....	....	
		C_E	4 05 –	....	....	....	....	
		F	4 08 00	....	....	....	....	Hardly anything on E-W except broken irregular waves.
23	......	L_N	5 30 00	....	....	....	....	Earthquake in Imperial Valley, Cal.
		L_E	5 30 00	....	....	....	....	
		M_N	5 30 00	12	....	87	....	
		M_E	5 30 00	10	37	....	....	Preliminary phases not visible on either component.
		C	5	....	....	....	....	
		F	5 50 ..	....	....	....	....	
24	......	....	....	....	....	....	....	Very small period waves on N-S from $10^h\ 30^m$ to $10^h\ 32^m$.

District of Columbia. **Washington. U. S. Weather Bureau.**

Lat., 38° 54′ N.; long., 77° 03′ W. Elevation, 21 meters.

Instrument: Marvin (vertical pendulum), undamped. Mechanical registration.

	V	T_0
Instrumental constants..	110	6

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
June 1	I_r ...	eP_N ...	14 52 37	....	....	....	4,400	
		iP_N ...	14 52 58	....	....	....	....	
		S_N? ...	14 58 47	....	....	....	....	
		L_E	15 09 27	22	....	....	....	Long waves nearly equal in intensity from $15^h\ 09^m\ 30^s$ to $15^h\ 18^m\ 00^s$.
		M_E	15 09 00	20	23	....	....	
		M_N	15 14 00	18	....	23	....	
		F	16 00 00	....	....	....	....	
6	I_u ...	iP_N ...	21 39 09	....	....	....	6,240	
		iS_E ...	21 46 58	....	....	....	....	
		L_E	21 54 24	22	....	....	....	
		M_E	21 54 55	....	20	....	....	
		F	23 30 00	....	....	....	....	
12	......	e_E	6 33 00	....	....	....	....	Phases not distinct.
		F	6 50 00	....	....	....	....	
22	I_u ...	P_N	3 34 03	....	....	....	6,750	Other phases not distinct.
		S	3 42 19	....	....	....	....	
		F	4 20 00	....	....	....	....	
23	I_r ...	eP_E ...	4 09 54	....	....	....	3,210?	Origin in Imperial Valley, Cal.
		S_N	4 14 52	....	....	....	....	
		M_N	4 16 10	7	....	32	....	Long waves not well marked.
		F	4 55 00	....	....	....	....	
23	I_r ...	P_N	5 06 07	....	....	....	3,690	Long waves not distinct.
		S_N	5 11 36	....	....	....	....	
		M_N	5 15 15	6	....	32	....	
		F	5 50 00	....	....	....	....	

District of Columbia. **Washington. Georgetown University.** F. L. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: Decayed diorite.

Instrument: Wiechert, 200 Kg., astatic horizontal pendulums.

		V	T_0	ε:1
Instrumental constants:	E	165	5.4	2.6
	N	143	5.2	3.4

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
June 1	......	eP_E ...	15 01 07	3	....	....	5,997	
		eP_N ...	15 01 08	4	....	1	....	
		$PR1_N$.	15 03 09	....	....	....	....	
		$PR2_N$.	15 03 30	4	....	....	....	
		S_N	15 08 07	6	....	2	....	
		S_E? ...	15 08 14	....	....	....	....	
		L_E	15 14 35	....	....	....	....	
		L_N	15 16 42	....	....	....	....	
		M_E	15 18 48	23	33	....	....	
		M_N	15 25 33	12	....	6	....	
		F_E	15 40 00	....	....	....	....	
		F_N	15 50 00	....	....	....	....	
6	......	eP_N ...	21 47 22	2	....	....	4,648?	
		P_E	21 47 58	....	....	....	....	
		S_N? ...	21 52 55	6	....	....	....	Record lost from $21^h\ 53^m$ to $21^h\ 55^m\ 30^s$ in change of record.
		L_N? ...	21 59 24	19	....	....	....	
		L_E	22 00 09	....	....	....	....	
		M_E	22 03 06	21	11	....	....	
		F_E	22 23 00	....	....	....	....	L_N irregular; no decided maximum.
		F_N	22 37 00	....	....	....	....	
23	......	P_E	4 10 01?	....	....	....	....	Imperial Valley, Cal.
		P_N	4 11 19	....	....	....	....	
		L_N	4 23 07	7	....	....	....	
		L_E	4 23 11	....	....	....	....	
		F_E	4 33 00	....	....	....	....	
		F_N	4 34 00	....	....	....	....	
23	......	P_N	5 08 12	....	....	....	....	Imperial Valley, Cal.
		P_E? ...	5 09 24	....	....	....	....	
		L_E	5 19 30	....	....	....	....	
		L_N	5 19 39	....	....	....	....	
		M_N	5 20 32	4	....	6	....	
		M_E	5 21 21	3	2	....	....	
		F_E	5 30 00	....	....	....	....	
		F_N	5 35 00	....	....	....	....	

Hawaii. **Honolulu. Magnetic Observatory.** U. S. Coast and Geodetic Survey. Wm. W. Merrymon.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association.

	T_0
Instrumental constant..	18.9

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
June 1	......	P	14 59 06	....	....	....	....	
		S	15 11 18	....	....	....	....	
		L	15 23 42	22	....	....	....	
		M	15 27 30	....	500*	....	....	
		C	15 41 30	....	....	....	....	
		F	16 50 18	....	....	....	....	
3	......	L	23 43 54	24	....	....	....	
		M	23 49 06	....	300*	....	....	
		F	23 55 12	....	....	....	....	
4	......	P	22 14 36	....	....	....	....	
		L	22 22 48	24	....	....	....	
		M	22 27 36	....	300*	....	....	
		C	22 39 12	....	....	....	....	
		F	23 12 36	....	....	....	....	
6	......	L	3 56 30	....	....	....	....	
		M	4 05 12	....	100*	....	....	
		F	4 14 24	....	....	....	....	
6	......	eP	7 20 54	....	....	....	....	
		L	7 24 42	....	....	....	....	
		M	7 28 00	....	200*	....	....	
		C	7 33 42	....	....	....	....	
		F	7 55 00	....	....	....	....	
6	......	L	8 49 00	....	....	....	....	
		M	8 53 30	....	100*	....	....	
		F	9 07 00	....	....	....	....	
6	......	P	19 54 24	....	....	....	....	
		L	20 02 18	26	....	....	....	
		M	20 08 54	....	1,400*	....	....	
		C	20 19 12	....	....	....	....	
		F	20 45 00	....	....	....	....	

TABLE 2.—*Instrumental seismological reports, June, 1915*—Continued.

Hawaii. **Honolulu. Magnetic Observatory**—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 6		P	21 43 30					
		S	21 47 36					
		L	21 53 00					
		M	21 54 48		2,500*			
		C	22 28 36					
7		F	0 43 36					
7		P	22 15 00					
		L	22 22 12	24				
		M	22 28 36		500*			
		C	22 33 18					
		F	23 19 48					
11		eP	3 52 12					
		M	3 59 12		100*			
		F	4 03 12					
11		eP	15 28 54					
		M	15 31 54		200*			
		C	15 42 24					
		F	16 25 06					
14		eL	3 49 00					
		M	3 54 24		200*			
		F	4 02 48					
18		L	0 12 30					
		M	0 22 30		200*			
		C	0 30 00					
		F	0 40 00					
23		L	4 16 24					
		M	4 19 24		400*			
		C	4 25 00					
23		L	5 14 24					
		M	5 16 12		300*			
		C	5 19 00					
27		P	15 41 30					
		L	15 48 54	22				
		M	15 55 00		1,200*			
		C	16 01 00					
		F	16 46 00					
29		P	13 56 42					
		L	14 07 42	22				
		M	14 12 12		500*			
		C	14 23 00					
		F	14 39 48					

*Trace amplitude.

Corrigendum.—This note in the REVIEW, February, 1915, should read as here.

Kansas. **Lawrence. University of Kansas.** Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 304.8 meters.

Instrument: Wiechert.

Instrumental constants	V	T_0	ϵ
E	177	3.7	4.0
N	205	3.7	3.8

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		P	15 54 08					
		S	16 05 49	15				
		L	16 10 ?	18-25	3	2		L waves lost in the P waves of another quake.
1		P	16 06 07					
		F	16 14 47					
6		P	21 50 ?	2				
		L	21 58 10	10	50	28		
23		P	4 02 33	2				Phases indistinct.
		L	4 07 46	10	8	28		
		F	4 27 00					
23		P	4 59 16	2-3				Phases indistinct.
		L	5 04 21	10	12	27		
		F	5 28 00					
29		P	23 49 23	2				
		L	23 54 39	12				

Maryland. **Cheltenham. Magnetic Observatory.** U. S. Coast and Geodetic Survey. George Hartnell.

Lat., 38° 44′ 00″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.

Instrument: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants	V	T_0
E	10	31
N	10	29

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		P	15 00 24	3				
		L	15 09 34	28				
		M_E	15 10 42	21	90			
		M_N	15 14 03	16		20		
		C	15 18 00	13				
		F	15 45 00	10				
6		P_N	21 39 20	3				
		S	21 47 05	4				
		L	21 54 22	22				
		M_E	21 54 45	16	20			
		M_N	21 58 52	17		50		
		C_N	22 15 00	16				
		F	22 31 00	14				
23		P_N	4 15 24	4				Only a few waves of P on E-W.
		L_N	4 15 53	10				
		M_N	4 16 18	12		50		
		C_N	4 17 00	8				
		F	4 25 00					
23		P_N	5 11 54	3				Nothing on E-W except a few waves of P.
		L_N	5 12 38	10				
		M_N	5 12 48	12		80		
		C	5 14 00	8				
		F	5 22 00					

Massachusetts. **Cambridge. Harvard University** Seismographic Station. J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instrument: Two Bosch-Omori, 100 kg., horizontal pendulums (mechanical registration).

Instrumental constants	V	T_0	ϵ:1
E	80	23	0
N	50	25	4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		*O*	14 43 50				5,100	
		eP	14 52 29					
		S_N	14 59 13					
		S_E	14 59 17					
		$SR1_N$	15 02 37	15				
		$SR1_E$	15 02 41	15				
		eL_E	15 05 08					Sinusoidals set in.
		L_N	15 07 09	26				
		L_E	15 08 47					
		M_E	15 12 33					
		C_E	15 17 03					
		F	16 15 00					
6		*O*?	.. .. ..					P and S lost in microseisms.
		P_E?	20 16 26					
		S_N?	20 33 54					
		L_E	20 38 07	30-20				
		F	20 50 00					
6		*O*	21 29 37				6,450	
		P_N	21 39 32					
		P_E	21 39 34					
		S_N	21 47 32					
		S_E	21 47 34					Amplitude (undamped) of S_E very large.
		M_E	21 47 53					
			21 49 31					No decided maximum of long waves.
			21 50 32					
		eL_E	21 54 14					
		eL_N?	21 54 30					
		F_N	22 58 00					
7		F_E	0 20 00					

Record from June 16 will not be issued until about October 1.

O=Time at origin.

TABLE 2.—*Instrumental seismological reports, June, 1915*—Continued.

Missouri. Saint Louis. St. Louis University. Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert 80 kg. astatic, horizontal pendulum.

Instrumental constants.. V 80, T_0 7, $\epsilon:1$ 5:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1	II_r	eS_E?	14 59 00				4,800	
		eL_E	15 04 30					
		M_E	15 14 12	13	30			
		F	15 37 00					
6	II_r	eS_E?	21 39 26				5,800	
		L_E	21 47 24					
		M_N	21 47 34	8		44		
		M_E	21 47 38	8	94			
		M_E	21 50 24	10	50			
		F	22 12 00					
22	I_r	i_E	3 41 48					
		eL_N	3 41 48					
		F	3 48 00					
23	II_r	eP_E	4 04 ?				2,450	
		L_E	4 10 00					
		L_N	4 10 00					
		F	4 20 30					
23	II_r	eP_E	5 03 ?				2,450	
		eP_N	5 03 00					
		S_N	5 06 12?					
		S_E	5 07 00					
		M_N	5 07 00					
		M_E	5 08 12	9	14			
		F	5 20 00					

New York. Buffalo. Canisius College. John A. Curtin, S. J.

Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.

Instrument: Wiechert, 80 Kg. horizontal.

Instrumental constants.. V 80, T_0 7, $\epsilon:1$ 5:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1	II_u	eP_N	14 50 10	2			6,200	Reported from Alaska.
		eS_E	14 57 00					
		eS_N	14 57 30	5				
		L_E	15 05 00					
		L_N	15 07 00					
		M_E	15 08 00	25	25			
		M_N	15 13 00	15		30		
		C_E	15 16 00					
		C_N	15 17 00					
		F_E	15 23 00					
		F_N	15 26 00					
3	I	i_E	19 04 00	3				This shock was preceded by intermittent earth tremors on E-W.
6	II_r	iP_N	21 37 45	10		2		
		iP_E	21 38 00					
		iS_N	21 46 00	15		3		
		iS_E	21 46 00	15	16			
		M	21 54 00	25				L and M waves interwoven with those of succeeding quake.
		F	22 11 00					
6	II_r	iP_N	21 38 30					
		iS_N	21 47 30			2		
		S_E	21 48 30					
		M	22 07 00	25				
		F	22 19 00					
23	I_r	eP	4 12 15					No record on E-W. S masked by microseisms. Reported from southern California.
		M	4 15 00	20		12		
		C	4 19 00					
		F	4 20 00					
23	I_r	eP	5 08 00					Not recorded on E-W. S masked by microseisms.
		M	5 10 00	18		18		
		C	5 11 30					
		F	5 14 00					
27	I_v	iP_E	22 35 10					
		iP_N	22 35 15					
		iS_E	22 36 10					
		M_N	22 36 30	8				
		M_E	22 36 30	15	2			
		F_N	22 36 45					
		F_E	22 36 50					

New York. Fordham. Fordham University. W. C. Repetti, S. J.

Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.

Instrument: Wiechert, 80 Kg.

Instrumental constants.. T_0: E 6.6; N 7.1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		eP_E	14 48 07					
		eP_N	14 47 59	4				
		S_N?	14 55 00	6				
		S_E	14 55 12	6				
		L_E	15 01 48					
		L_N	15 02 48					
		M_E	15 05 39	20	335			
		M_N	15 05 59	22		210		
		F_E	15 52 00					
		F_N	15 56 00					
3-4								Microseisms on the 3d-4th.
6		eP_N	21 34 52					
		eP_E	21 35 05	2				
		S_N	21 42 43					
		S_E	21 42 50					
			21 42 53	7	13			
		S_N	21 43 01	8		10		
		L_N	21 51 46					
		L_E	21 52 05					
		M_N	22 01 00	21		140		
		F_E	22 12 00					
		F_N	22 47 00					
23								Record received of the California earthquake, but time marks failed to record.

Panama, Canal Zone. Balboa Heights. Isthmian Canal Commission.

Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, ——.

Instruments: Two Bosch-Omori 25 kg.

Instrumental constants.. V 8, T_0 20

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 6	I_v	P_E	14 35 25				1,600	
		P_N	14 35 30					
		L_E	14 40 15					
		L_N	14 40 15					
		M_N	14 42 05			250		
		M_E	14 45 50		62			
		F_E	14 52 50					
		F_N	15 10 05					
17	II_v	P_N	5 33 28				485	Direction probably southwest.
		P_E	5 33 30					
		L_N	5 34 28					
		L_E	5 34 30					
		M_E	5 34 39		75			
		M_N	5 34 45			125		
		F_E	5 39 08					
		F_N	5 40 30					
28	III_v	P_E	8 27 01				145	Direction southeast.
		P_N	8 27 16					
		L_E	8 27 16					
		L_N	8 27 31					
		M_N	8 27 31			1,250		
		M_E	8 27 36		250			
		F_E	8 28 01					
		F_N	8 29 26					

Porto Rico. Vieques. Magnetic Observatory. U. S. Coast and Geodetic Survey. H. M. Pease.

Lat., 18° 09′ N.; long., 65° 27′ W. Elevation, 19.8 meters.

Instruments: Two Bosch-Omori.

Instrumental constants.. E: V 10, T_0 21.4; N: V 10, T_0 21.1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 6		P	21 37 27	5				
		S	21 41 58	8				
		L	21 45 00	12				
		M	21 46 06	12	350	180		
		C	21 56 00	11				
		F	22 42 00	10				
29	I_d	L	0 35 37					Felt by several people in Vieques.
		M	0 35 42		10	10		
		F	0 35 54					

TABLE 2.—*Instrumental seismological reports, June, 1915*—Continued.

Vermont. **Northfield. U. S. Weather Bureau.** Wm. A. Shaw.

Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.

Instruments: Two Bosch-Omori, mechanical registration.

Instrumental constants	V	T_0
E	10	15
N	10	16

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1	I_r	eP_N	14 52 12				4,885	
		S_N	14 58 48					
		L_E	15 07 02	22				
		M_E	15 10 30	16	20			
		M_E	15 11 30	14	20			
		F	16 00 00					
6	I_u	eP_N	21 39 45				6,750	Long waves not well developed.
		S_N	21 48 01					
		F	23 15 00					
22		M_E	3 43 35		25			Other phases indistinct.
		M_E	3 44 16		25			
		F	4 00 00					
		eS_N?	4 15 06					Origin in southern California.
23		M_N	4 17 56	12		125		
		F	4 40 02					
23	I_r	eP_N	5 06 40				3,360	Origin in southern California.
		S_N	5 11 48					
		M_N	5 14 32	12		125		Record on E-W very faint.
		F	5 40 00					

Canada. **Ottawa. Dominion Astronomical Observatory.** Earthquake Station. Otto Klotz.

Lat., 42° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.

Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80 kg. vertical seismograph.

Instrumental constants.. V 120 T_0 26

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 1		eP_N	14 52 03				4,860	
		iP	14 52 07					
		PR_N	14 53 49					
		S	14 58 38	5				
		eL_E	15 04 08	36				
		eL_N	15 04 09	40				
		L_E	15 06 00	26				
		L_N	15 07 00	26				
		L_E	15 07 00	20				
		M_E	15 07 05	20	50			
		M_N	15 10 00	18		60		
		L_E	15 11 *to*	12				
			15 44 00	11				
		F	16 10 00					
4		eL	21 30 08	20				
		L_E	21 32 00	10				
		F	21 35 00					
4		e_E	22 21 22	6				
		L	22 50 04	24-20				
		L_E	22 58 00	12				
		L_N	23 03 29					
		F	23 05 00					

Canada. **Ottawa. Dominion Astronomical Observatory**—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
June 5		L_E	20 02 *to*	22				
			20 05 00	22				
5		e	20 15 33	4				
		e	20 25 22					
		F	20 30 00					
6		eL_E	20 38 02	24				
		eL_N	20 41 02	20				
		L_E	20 42 00	20				
		L_E	20 45 00	18				
		L_E	20 53 00	16				
		F	21 00 00					
6		iP_N	21 39 53	5			6,940	
		iS	21 48 19	5	25	9		
		i	21 49 30	5				
		i_E	21 50 49	5				
		eL_N	21 56 02	40				
		eL_E	21 56 07	44				
		L	22 01 00	20-18				
		L_E	22 11 00	20				
		L_N	22 13 00	17				
		L_E	22 16 00	16				
		i_N	22 32 03	5				
		L	22 38 00	14				
		L	22 48 00	14				
		F	24 00 00					
7		e	12 26 00	6				
		eL_E	12 26 00	20				
		L_E	12 28 00	18				
		F	12 35 00					
12		e_N	6 32 00					By mishap spotlight not on E-W.
		e_N	6 40 00					
		eL_N	6 46 03	20				
		L_N	6 49 00	14				
		L_N	6 52 00	12				
		F	7 00 00					
22		iP_N	3 34 58				7,210	
		iS	3 43 38	6				
		SR2?	3 51 02	11				
		eL_N	3 54 05	22				
		eL_E	3 55 00	22				
		L	4 00 00	11				
		F	4 15 00					
23		eP_N?	4 10 14				3,700	In southern California.
		iS_N	4 15 43	3				
		S_E	4 16 00					
		M_N	4 16 58	5		5		
		M_E	4 17 24	10	2			
		eL	4 18 03	20-18				
		F	4 55 00					
23		eP_N?	5 06 48				3,700	
		iS_N	5 12 19					
		S_E	5 12 36					
		M_N	5 13 34	5		10		
		M_E	5 15 36	10	4			
		eL	5 15 50	20-10				
		F	5 55 00					

TABLE 3.—*Late seismological reports.* (*Instrumental.*)

New York. Buffalo. Canisius College. John A. Curtin, S. J.

Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.

Instrument: Wiechert 80 kg. horizontal.

Instrumental constants.. V 80, T_0 7, ε:1 5:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Apr. 1			14 18 30					Earth tremors on N-S.
			14 19 30					
2			14 00 00					Earth tremors on N-S.
			14 20 00					
3								Earth tremors per day and night on N-S.
23	I	i_N	15 36 45	3		12		
		i_E	15 36 45	1				
23	I	i_N	15 43 15	5		38		
		i_E	15 43 15	3	25			
		F	15 46 30					
24-25								Earth tremors on E-W on 24th and 25th.
May 1	II_u	eP	5 12 45	3			8,976?	E-W component not recorded; pen being repaired.
		eS	5 22 45	5				
		L	5 43 00					
		M	5 47 00	30		62		
		M	5 50 00	25				
		M	5 53 00			62		
		C	5 58 00	15				
		C	6 00 00	10				
		C	6 04 00					
		C	6 31 00					
		F	6 46 00					
6	II_r	eP	12 21 40				2,340	Pen of E-W component not working properly.
		eS	12 23 50					
		L	12 26 30	10				
		M	12 28 00	15		16		
		C	12 30 00	8				

Canada. Toronto. Dominion Meteorological Service.

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand an clay.

Instrument: Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1 mm. swing of boom = 0.59″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Apr. 2		P	6 02 30					
		L	6 12 06					
		M	6 14 30		200*			
		F	6 19 48					
3		P	20 49 06					
		L	21 00 54					
		iL	21 06 42					
		iL	21 10 48					
		M	21 11 12		500*			
		F	21 45 48					
3		P?	22 00 00					
		L	22 05 24					
		M	22 06 42		100*			
		F	22 32 36					
7		L	16 15 30					
		iL	16 16 18					
		M	16 16 48		300*			
		F	16 20 48					
7		L	16 35 48		50*			
		F	16 43 12					
8		L	14 44 12		200*			
		F	14 51 54					
23		P?	15 38 48					
		S	15 44 12					
		L	15 52 42					
		L	16 00 00					
		M	16 01 00		200*			
		F	16 14 12					
28		P	4 04 30					
		L	4 16 48					
		M	4 23 54		100*			
		F	4 34 00					

* Trace amplitude.

Canada. Toronto. Dominion Meteorological Service—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Apr. 30		P?	2 15 48					
		L	2 39 12		50*			
		F	3 03 24					
May 1		iP	5 12 24		300*		7,700	A well-marked disturbance. Long waves continued for a long time. Three elongated cigar-shaped movements before and just after M.
		iP	5 15 12					
		S	5 22 12		2,300*			
		L	5 31 12	18	1,300*			
		L	5 42 12		2,300*			
		M	5 45 06		8,200*			
		iL	5 48 24					
		M	5 51 42	18-24	12,000*			
		M	5 52 42		8,500*			
		iL	5 56 36		4,300*			
		iL	5 58 54					
		C	6 02 06	24				
		C	6 03 12					
		M	6 05 12		4,300*			
		L	6 59 00		800*			
		L	7 02 18					
		L	7 20 12					
		iL	7 38 00					
		L	8 01 24					
		L	9 20 00					
		F?	9 23 48					
1		L?	9 25 54					Possibly a dual earthquake with the preceding, or repeat.
		L	9 29 30					
		M	9 31 06		200*			
		M	9 35 18					
		F	9 58 12					
1		L	11 19 42		100*			Slight thickeness of line.
		F	11 33 00					
2		P	4 31 12					Well-marked light disturbance.
		S	4 40 24					
		L	4 44 24					
		M	4 50 42		400*			
		L	4 53 54					
		F	5 20 54					
3		P	3 45 54					
		S	3 51 00					
		L	3 55 06					
		L	3 59 06					
		M	4 05 42		1,300*			
		L	4 08 48					
		L	4 36 48					
		F	4 47 30					
3		P	4 50 12					
		L	5 03 06					
		L	5 11 18					
		M	5 27 42		400*			
3		P?	6 06 24					P mixed up with trailers of preceding earthquake.
		S	6 15 [illegible]					
		iL	6 21 36					
		M	6 22 54		300*			
		F	6 40 18					
5		P	12 04 48					
		L	12 20 12					
		M	12 30 48		300*			
5		P?	13 13 12					P mixed up with trailers of preceding quake.
		iL	13 28 42		200*			
		F	14 06 00					
6		P	12 17 30					
		S	12 21 48					
		S	12 25 42					
		iL	12 29 24		600*			
		L	12 29 48					
		L	12 31 00					
		M	12 31 48		800*			
		F	13 01 18					
8		L?	14 48 54					P lost in local vibrations.
		L	14 52 12					
		M	14 52 36		300*			
		F	15 17 00					
12		P?	10 43 54					
		S	10 50 00					
		L	11 04 12					
		L	11 11 30					
		M	11 13 30		300*			
		F	12 13 00					
12		P?	17 07 42					
		S	17 09 18					
		L	17 15 36					
		M	17 16 30		200*			
		F	17 27 54					

* Trace amplitude.

TABLE 3.—*Late seismological reports.* (*Instrumental*)—Continued.

Canada. Toronto. Dominion Meteorological Service—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. M. S.*	*Sec.*	μ	μ	*Km.*	
May 14		iP	7 12 00?					P and S phases doubtful.
		iS	7 18 00?					
		iL	7 21 00					
		L	7 30 18					
		M	7 32 06		300*			
		L	7 35 12					
		F	8 06 06					
17		L	13 27 24					
		M	13 30 12		100*			
		F	13 40 24					
18		L	15 11 48		100*			P and S not recorded.
		F	15 15 42					
21		L	5 11 06					P and S not recorded.
		L	5 14 36					
		M	5 16 24		300*			
		M	5 20 36		300*			
		iL	5 29 30					
		M	5 31 00		200*			
		F	5 45 06					
29		L	0 34 24		50*			
		F	0 56 42					
29		L	7 04 42		50*			
		F	7 08 48					

Canada. Victoria, B. C. Dominion Meteorological Service.

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instrument: Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation: 1 mm. swing of boom = 0.54″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. M. S.*	*Sec.*	μ	μ	*Km.*	
Apr. 2		P	0 18 54					
		L	0 20 24					
		M	0 20 54		200*			
		F	0 24 54					
3		P	20 41 54					
		L	20 46 54					
		M	20 59 54		300*			
		F	21 26 24					
3		P	21 42 48					
		L	21 49 36		100*			
		F	22 07 36					
7		P	16 18 00					
		L	16 20 00					
		M	16 20 18		100*			
		F	16 23 48					
8		P	14 37 42					
		L	14 38 42					
		M	14 41 12		400*			
		F	14 45 42					
23		P	15 40 06					
		L	15 48 18					
		M	15 49 06		400*			
		F	16 08 36					
26		P?	19 00 18		100*			
		L	.. .. ..					
		F	19 02 18					
28		P	4 05 54					
		L	4 09 24					
		M	4 10 24		200*			
		F	4 25 24					
30		P	2 11 30					
		L	2 29 30					
		M	2 35 00		200*			
		F	2 58 30					

* Trace amplitude.

Canada. Victoria, B. C. Dominion Meteorological Service—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E.	Amplitude. A_N.	Distance.	Remarks.
1915.			*H. M. S.*	*Sec.*	μ	μ	*Km.*	
May 1		iP	5 08 30	18			4800?	Well-defined disturbance. Long waves continued for several hours.
		iP	5 10 24					
		P	5 13 36					
		iS	5 15 48		1800*			
		iL	5 20 24	30	2800*			
		M	5 35 30					
		M	5 38 48	18–30	6500*			
		L	5 39 42	18				
		C	5 45 12					
		C	5 47 06	18				
		iL	6 08 30	18–30	4300*			
		F	9 10 30					
1		P	9 12 30					
		S	9 15 30					
		L	9 20 00					
		M	9 20 30		300*			
		F	9 53 30					
2		P	4 32 24					
		L	4 34 54					
		M	4 36 54		500*			
		F	5 16 24					
3		P	3 35 00					
		S	3 38 36					
		L	3 43 24					
		L	3 47 24					
		M	3 51 54		600*			
3		P	4 49 24					Beginning confused with trailers of preceding.
		L	4 52 24					
		M	4 55 24		500*			
		F	5 37 24					
3		P	6 01 48					
		L	6 07 42		50*			
		F	6 39 06					
5		P	11 56 18					
		L	11 59 18					
		M	12 03 48		200*			
		F	12 32 18					
6		P	12 12 54					
		L	12 13 24					
		M	12 14 54		400*			
		F	13 08 24					
8		P	15 02 30					
		L	15 10 30					
		M	15 12 30		100*			
		F	15 27 30					
12		P	11 14 06					
		S	11 20 36					
		L	11 24 06					
		M	11 33 36		500*			
		F	12 02 06					
12		P	16 56 06					
		S	16 58 06					
		L	17 00 36					
		M	17 01 36		100*			
		F	17 05 36					
14		P	7 07 42					
		L	7 13 12					
		M	7 17 12		300*			
		F	8 02 12					
17		L	13 44 00		50*			
		F	13 46 00					
21		L	5 30 54					Measurements doubtful.
		L	5 35 42					
		M	5 38 06		50*			
		F	5 44 42					
23		P	23 26 42					
		L	23 29 12					
		M	23 29 42		100			
		F	23 31 42					
29		P	6 48 18					
		L	6 53 18					
		M	6 53 48		200*			
		F	7 01 18					

* Trace amplitude.

SECTION VI.—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be of use to Weather Bureau officials in their meteorological work and studies:

Abbot, C. G., Fowle, F. E., & Aldrich, L. B.
New evidence of the intensity of solar radiation outside the atmosphere. Washington. 1915. 55 p. 24½ cm. (Smithsonian miscellaneous collections, v. 65, no. 4.) [Abstract in this REVIEW, May, 1915, p. 212.]

Alaska. Agricultural experiment stations.
Report, 1914. Washington. 1915. 96 p. plates. 23 cm. [Contains condensed meteorological reports; also text descriptions of climate.]

Annuaire astronomique et météorologique.
51e année, 1915. Par Camille Flammarion. Paris. n. d. 436 p. 18½ cm.

Benkendorff, Rudolf.
Die Isothermen Schleswig-Holsteins und klimatische Messungen auf Föhr. Kiel. 1914. 42 p. 23 cm. (Inaug.-Diss.—Kiel.)

Fortschritte der Physik.
3. Abteilung. Kosmische Physik. Braunschweig. 1914. lviii, 582 p. 23½ cm.

Greifswald. Meteorologische Station.
Die Ablesungen vom 1. Januar bis 31. Dezember 1913, nebst Jahresübersicht über das Jahr 1913. Greifswald. 1914. 50 p. 22 cm.

Hamburg. Deutsche Seewarte.
Deutsches meteorologisches Jahrbuch für 1913. Beobachtungs-System der Deutschen Seewarte. Jahrgang 36. Hamburg. 1915. iv, 80 p. 32½ cm.

Havana. Observatorio del Colegio de Belén.
Año de 1914. Habana. 1915. 7 p. tables. 36½ cm.

Hegyfoky, Kabos.
Az Atlanti-óceán hatása idöjárásunkra. [The influence of the Atlantic Ocean upon the weather in Hungary.] Budapest. 1914. 13 p. 25½ cm. (Különlenyomat a "Természettudományi közlöny" 115–116. pótfüzetéből.) [In Hungarian.]
A monszun Indiában és a Nagy-Alföldön. [The monsoon in India and on the great Hungarian plane.] Budapest. 1914. 7 p. 25½ cm. (Különlenyomat a "Természettudományi közlöny" 599. füzetéből.) [In Hungarian.]

Hellmann, G[ustav].
Über die Verteilung der Niederschläge in Norddeutschland. [Berlin. 1914.] 980–990 p. 25½ cm. (*S.-A.* Sitzungsberichte der K. preuss. Akademie der Wissenschaften, 38, 1914.)

Hongkong. Royal observatory.
Report of the director for the year 1914. Hongkong. 1915. 16 p. 24½ cm.

India. Meteorological department.
Memoirs, v. 19, [nos.] v–vi. Calcutta. 1915. 217–274 p. lvii–lxxxvi pl. 31 cm. [Contains discussions of anemographic observations recorded at Jubbulpore from May 1889, to April 1900, and at Belgaum from May 1881 to April 1904, by W. A. Harwood.)
Memorandum on the meteorological conditions prevailing in the Indian monsoon region before the advance of the southwest monsoon of 1915, with an estimate of the probable distribution of the monsoon rainfall in 1915, by G. C. Simpson. Simla. 1915. 3 p. 33½ cm.

Kimball, D. D., & Palmer, George T.
Experimental laboratory of the New York State commission on ventilation and a description of the first year's work. n. p. [1915.] 74 p. 25 cm.

Krebs, Wilhelm.
Witterungsverlegung von indischen bis nach skandinavischen Breiten. Wien & Leipzig. [1915.] 410–424 p. map. 24 cm.

Mazelle, Eduard.
Flaschenposten in der Adria zur Bestimmung der Oberflächen strömungen. Wien. 1914. 43 p. 4 pl. 30 cm. (Aus dem 91. Bande der Denkschriften der math.-naturw. Kl. der Kais. Akademie der Wissenschaften.)

Meinardus, W[ilhelm].
Meteorologische Ergebnisse der Seefahrt des "Gauss" 1901–1903, und Ergebnisse der Luftdruckbeobachtungen der Internationalen meteorologischen Kooperation 1901–1904. Berlin. 1913. viii, 245–452 p. 35½ cm. (Deutsche Südpolar-Expedition 1901–1903. 4. Band: Meteorologie Band 2. Tabellen. Heft 3.)

Milan. R. Osservatorio astronomico di Brera.
Osservazioni meteorologiche e geofisiche, 1914. Ser. 3, v. 6. Milano. 1915. xviii, 53 p. 4 pl. 30½ cm.

Norway. Meteorologiske institut.
Jahrbuch für 1914. Kristiania. 1915. xii, 147 p. 33 cm.
Nedbøriagttagelser i Norge, aargang 20, 1914. Kristiania. [1915.] xi, 65 p. map. 37½ cm.

Osaka. Meteorological observatory.
Annual report for the year 1914. Osaka. 1915. 2 pts. 25½ cm.

Philippine Islands. Weather bureau.
Annual report for the year 1912. Part 3: Meteorological observations made at the secondary stations. Manila. 1914. 319 p 29 cm.

Pickering, William H.
Meteorology of the moon. 12 p. front. 24½ cm. (*Reprinte from* Popular astronomy, v. 23, no. 3, March, 1915.)

Pohl, R[obert], & Pringsheim, P[eter].
Die lichtelektrischen Erscheinungen. Mit 36 Textabbildungen. Braunschweig. 1914. 3 p. l., 114 p. 22½ cm. (Sammlung Vieweg: Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 1.)

Rosenthal, E[lmar H.]
Ob opredíelenii glubiny ochaga zemletríasenía. Vtoroe soobschenie. [On the determination of the depth of earthquak foci. Second communication.] Petrograd. 1915. 41–96 p. 30½ cm. [In Russian. Published by the Imperial academy o sciences.]

S, M.
Gorizontal'nyĭ pochvennyĭ termometr dlía nebol'shikh glubin. [Horizontal soil-thermometer for small depths.] Blagovíeshchensk. 1915. 38 p. 25½ cm. (Ottisk iz Izvíestiĭ Meterologicheskago bíuro Amurskago raĭona, vypusk 3.) [In Russian]

Southport. Fernley observatory.
Report and results of observations, for the year 1914, by Joseph Baxendell. Southport. 1915. 52 p. 25 cm.

Sucre. Observatorio meteorológico del Instituto médico.
Bolétin meteorológico, año 1915. Trabajos cientificos y resultados de las observaciones meteorológicas. Sucre. 1915. 32–80 p. 23 cm.

Thiessen, Alfred H.
Story of the thermometer and its uses in agriculture. Washington. 1915. 2 p. l. 157–166 p. 23 cm. (From Yearbook of Department of agriculture for 1914.)

Upsala. Observatoire météorologique de l'Université.
Bulletin mensuel, v. 46, 1914. Par F. Åkerblom. Upsala. 1914–1915. 34 cm.

Voznesenskiĭ, A. V., & Shostakovich, V. B.
Osnovnyía dannyía dlía izuchenía klimata Vostochnoĭ Sibiri, s atlasom. [Fundamental data for the study of the climate of Eastern Sibiria, with atlas.] Irkutsk. 1913. 2 v. 27 cm. & 23 x 35 cm. (Yeniseisk. Pereselencheskoe upravlenii. [Publication]) [In Russian.]

Woodman, Alpheus G., & Norton, John F.
Air, water, and food from a sanitary standpoint. 4th ed., rev. & rewritten. New York & London. 1914. v, 248 p. 23½ cm. [Chapter 2: Air and health. Chapter 3: Air, analytical methods.]

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Professor in charge of Library.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

British association for the advancement of science. Report. 84th meeting, Australia, 1914. London. 1915.

Simpson, G[eorge] C. Discussion on antarctic meteorology. p. 302. [See this REVIEW, July 1915.]

Anderson, V. G. The influence of weather conditions upon the amounts of nitric acid and of nitrous acid in the rainfall near Melbourne, Australia. p. 338-339. [See this REVIEW, July 1915.]

Engineering news. New York. v. 74. 1915.

Stegner, C. M. Cincinnati buildings suffer from wind storm. p. 140-142. (July 15.)

Bunnemeyer, B[ernard]. The April floods in Texas. p. 152. (July 22.)

London, Edinburgh and Dublin philosophical magazine. London. 6 ser. v. 30. July, 1915.

Simpson, G[eorge] C. The electricity of atmospheric precipitation. p. 1-12. [Bibliography, p. 12.]

Deeley, R. M. The theory of the winds. p. 13-33.

Nature. London. v. 95. June 24, 1915.

Grabham, G. W. Man's true thermal environment, p. 451.

Physical review. Lancaster, Pa. v. 6. July, 1915.

Hersey, M. D. Aneroid barometers. p. 75-77. [Abstract.]

Royal society. Proceedings. London. ser. A. v. 91. no. A631. 1915.

Lees, Charles H. On the shapes of the equipotential surfaces in the air near long walls or buildings and on their effect on the measurement of atmospheric potential gradients. p. 440-451.

Science. New York. v. 41. June 11, 1915.

Livingston, Burton E. A modification of the Bellani porous plate atmometer. p. 872-874.

Science abstracts. London. v. 18. Feb. 25, 1915.

Ho., H. H. Radium as a lightning conductor. p. 94-95. [Abstract of paper by Szilard.]

Scientific American supplement. New York. v. 80. 1915.

Facts about thunderstorms. p. 37-38. (July 17.) [Abstract of paper by Prof. Humphreys in MONTHLY WEATHER REVIEW, June, 1914, p. 348-380.]

Scientific American supplement—Continued.

Wolf, Karl. The nature of ball lightning. A curious phenomenon, and attempts to explain its nature and action. p. 54-55. (July 24.) [Translated from "Prometheus."]

Académie des sciences. Comptes rendus. Paris. Tome 160. 1915.

Hubert, Henri. Sur la répartition des pluies en Afrique occidentale. p. 606-608. (3 mai.)

Boussinesq, J. Calcul approximatif de l'influence du climat sur la vitesse d'accroissement de la température avec la profondeur sous le sol. p. 747-750. (14 juin.)

Eginitis, D[imitrios]. Sur les derniers tremblements de terre de Leucade et d'Ithaque. 774-777. (14 juin.)

Archives des sciences physiques et naturelles. Genève. Tome 39. 19 mai 1915.

Mercanton, Paul L[ouis]. Un nouveau néphéloscope. p. 454-455.

Beiträge zur Physik der freien Atmosphäre. Leipzig. 7. Band. Heft 2. 1915.

Dietzius, R[obert]. Steig- und Fallgeschwindigkeit des Freiballones. p. 35-50.

Schmidt, Wilhelm. Häufigkeitverteilung des vertikalen Temperaturgradienten. p. 51-76.

Dietzius, Robert. Die Beständigkeit des Windes in verschiedenen Höhen über Wien. p. 77-86.

Kohlhörster, Werner. Messungen der durchdringenden Strahlung bis 9300 m Höhe. p. 87.

Schedler, Anton. Über den Einfluss der Lufttemperatur in verschiedenen Höhen auf die Luftdruckschwankungen am Erdboden (nach den internationalen Ballonaufstiegen). p. 88-101.

Meteorologische Zeitschrift. Braunschweig. Band 32. Juni 1915.

Hellmann, G[ustav]. System der Hydrometeore. p. 241-253.

Wegener, Alfred. Zur Frage der atmosphärischen Mondgezeiten. p. 253-258.

Hann, J[ulius] v. P. Range über das Klima des Namalandes, Deutsch-Südwestafrika. p. 258-268.

Hegyfoky, J[akob]. Der jährliche Temperaturgang auf der grossen Tiefebene in Ungarn. p. 268-273.

Köppen, W[ladimir]. Die Bestimmung der Luftströmungen in der Höhe mittels Pilotballon. p. 273-277.

Sverdrup, H. U. Temperaturinversionen in etwa 4000 m Höhe in der Nähe der Alpen. p. 283-284.

Der Frühjahrszug der Vögel und das Wetter. p. 284. [Abstract of article by Hegyfoky.]

Russia. Bureau météorologique du comité scientifique du Ministère de l'agriculture. Travaux de météorologie agricole. Petrograd. Livraison 14 1915.

Azzi, Girolamo. L'importance de la météorologie agricole au point de vue international. p. 3-18. [Russian, with French translation.]

Azzi, Girolamo. L'influence des facteurs météorologiques sur les rendements du froment dans la province de Bologne. p. 19-47. [Russian, with French translation.]

Geografia. Novara. anno 3. Marzo-aprile 1915.

Baratta, Mario. Le condizioni sismiche della regione marsicana. p. 106-111.

SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF THE MONTH.

P. C. DAY, Climatologist and Chief of Division.

[Dated: Weather Bureau, Washington, August 2, 1915.]

PRESSURE.

The distribution of the mean atmospheric pressure over the United States and Canada, and the prevailing direction of the winds are graphically shown on Chart VII, while the average values for the month at the several stations, with the departures from normal, are shown in Tables I and III.

For the month as a whole the barometric pressure was high over all sections, except the coastal portion of the South Atlantic and east Gulf States, in the lower Ohio Valley, Arkansas, Oklahoma, southeastern Kansas, central Texas, and New Mexico, where the means were near or slightly below normal. The greatest plus departures appeared in the eastern Canadian Provinces and over the north Pacific coast.

The month opened with pressure near or slightly above normal in nearly all districts, except in the South Atlantic and east Gulf States and the Rocky Mountain region where relatively low pressure obtained. During the first and second decades moderately high pressure continued throughout most districts, although occasional rather well defined low areas crossed the country. During the third decade there were only slight daily variations and the pressure was generally near or slightly above normal, until near the close when pressures generally below the normal prevailed to the eastward of the Rocky Mountains, except in the extreme southeast, while in the Rocky Mountain region and to the westward they were slightly above normal.

The distribution of the highs and lows was generally favorable for southerly and southwesterly winds along the immediate Atlantic and Gulf coasts except the Florida Peninsula, southerly and southeasterly in the west Gulf and Southern Plains States, and northerly and northwesterly on the Pacific coast, except in the extreme north and south portions. Elsewhere variable winds prevailed.

TEMPERATURE.

At the beginning of June temperatures near the normal prevailed in all portions of the country, save in the extreme Northeast and in the Far West where cool weather obtained. About the middle of the first week, an area of decidedly cool weather overspread the northern Mountain region, the Great Plains, and upper Mississippi Valley, with minimum temperatures at points on the eastern slope of the Rocky Mountains at or near the freezing point. At the close of the week another cool area moved into the Missouri Valley and temperatures near the freezing point were reported from the Dakotas; there was a decided lowering of temperature also in the Lake region and over much of the Ohio Valley. The mean temperature for the week was below the normal over the principal cereal-producing sections of the country, while in the Gulf States, along the northern border from the Lake region eastward, and in the Far West, average temperatures were near or slightly above the normal.

Cool weather overspread the Far West, the upper Mississippi Valley and the districts to the eastward during the first few days of the second week, but there was a general warming up in the Plains States and to the east. By the middle of the week the weather had grown warmer in nearly all districts, although during the latter part it became cooler over the middle Mountain and Lake regions and the adjoining districts. Moderate summer temperatures continued in the East, South, and far West. At the close of the week moderately cool weather was the rule in the Mountain and Western districts, with some sharp falls in temperature in the Northwest, and readings were close to freezing in the upper Missouri Valley. The weekly mean temperature was below the normal over most of the central and northern districts, while over the Atlantic and Gulf States, and the immediate California coast, it was near or a few degrees above the normal.

Warm, sultry weather obtained at the beginning of the third week over eastern districts, but west of the Mississippi moderate temperatures were the rule. Toward the middle of the week cooler weather occurred in the northern districts, with light frosts at exposed points in the Lake Superior district. At the same time higher temperatures overspread the Middle West. During the latter part of the week the temperatures were generally high in the South, but cooler weather prevailed over northern districts, light frosts forming in the mountains of the far Northwest. At the close of the week cool weather prevailed over the interior districts, while moderate summer temperatures continued in the South and it remained cool in the far West. The week as a whole was decidedly cool from the Great Lakes westward to the Rocky Mountains. In the South, however, the averages were generally several degrees above the normal.

During the first few days of the fourth week cool weather prevailed generally over the interior of the country. In the far West moderate temperatures obtained until after the middle of the week, when considerably cooler weather overspread the Plateau region. In the meantime warmer, humid, weather set in over the Middle West and continued until the latter part of the week, and in the South it remained warm. By the close of the week cooler weather prevailed over most districts from the Plains region westward, and in the Missouri and upper Mississippi Valleys and the districts to the eastward. The mean temperature for the week was below the normal over most northern and central districts, being decidedly low in the Lake region, the Ohio Valley, and eastward to the Atlantic coast. Only in small districts in the South, along the immediate Pacific coast, and at a few points in the upper Missouri Valley were the averages equal to or above the normal.

PRECIPITATION.

During the first few days of the month rain fell over the more eastern districts, the far Northwest, and portions of the Rocky Mountain and Plateau regions, the falls being unusually heavy in portions of the Atlantic and east Gulf States and at points in Utah and Wyoming. As the first week advanced rains became more general in the Northwest and extended into the Mississippi and Ohio Valleys and the Lake and middle Plains regions, with rather copious amounts in portions of the Missouri Valley, Kansas, Oklahoma, and adjacent States. At the close of the week generally fair weather prevailed, except for local rains in the East, the South, and along the

northern border from Lake Superior to the Rocky Mountains. The week was cloudy and wet over the Great Plains region, copious rains occurring from northern Texas to the Dakotas and westward into the Mountain and plateau districts. It was wet also over much of the Middle and South Atlantic States, and moderate rains fell over most other districts east of the Rocky Mountains, save over the northeastern States, in central and southern Texas, and eastward over the middle Gulf States, where practically no rain occurred.

The first few days of the second week were mostly free from rain, except in the northern districts between the Rocky Mountains and the Great Lakes, where light showers prevailed at intervals. About the middle of the week heavy rains occurred in the Dakotas, Minnesota, and Montana, while moderate showers fell from the central portions of the middle Gulf States and northern Texas northeastward over most sections to the Atlantic. At the close of the week rains occurred over wide areas from the west Gulf States northeastward to the lower Lake region and at scattered points to the northwest, while in the Plains region and Southwest the weather was mostly clear. For the week as a whole generous amounts of rain fell in Montana, portions of the northern Plains States, and in the lower Missouri, lower Mississippi, and Ohio valleys, while light showers occurred in the cotton belt to the eastward of the Mississippi River, in the Atlantic Coast States, and in the region of the Great Lakes. In the coast and southwestern districts of Texas, the central and southern Plateau districts, the southern Rocky Mountain region and in California, no rain occurred.

The extensive rain area over the eastern districts at the beginning of the third week moved off the Atlantic coast during the following few days, with copious falls at points near the coast. About the middle of the week rain overspread the Missouri and upper Mississippi valleys and local heavy falls were reported from points in Kansas and surrounding districts, the amount at Concordia, Kans., in 48 hours exceeding 6 inches. Sharp rises occurred in many of the streams of Kansas, Missouri, and surrounding districts, and much damage resulted from flooding of crops, and otherwise. During the following few days the rain area advanced eastward to the Lake region and the Ohio Valley, and copious rains fell at many points in those regions. At the close of the week fair weather prevailed over much of the interior of the country. The rainfall for the week was heavy throughout most of the Plains region, and generous in the central and lower portions of the Ohio Valley, the region of the Great Lakes, and in most of the Atlantic Coast States. In the central and western portions of the cotton belt, except Oklahoma and northern Arkansas, but little rain occurred, and precipitation was absent over much of Texas and west of the Rocky Mountains, save for local showers in the northern districts.

No well-defined precipitation area crossed the country during the fourth week, and such precipitation as occurred resulted mostly from local thunderstorms. These were widely scattered, but considerable rain occurred each day with occasional heavy falls, especially about the middle of the week in the central Plains region, and portions of the Gulf States, lower Missouri and upper Mississippi valleys. At the close of the week scattered showers occurred in portions of the Southeast, the middle Plains region, and the upper Mississippi and lower Ohio valleys. The total fall for the week was generous in portions of the Gulf and Plains regions and the upper Mississippi Valley, and good rains occurred in portions of the South Atlantic States. Only moderate amounts fell in the Lake region, the Ohio Valley, and to the eastward, considerable areas in these districts receiving no appreciable amounts during the week. Practically no rain occurred over much of Texas and to the westward of the Rocky Mountains, except at a few scattered points in the more northern districts.

SUMMARY.

The marked features of the weather during June, 1915, were the persistent low temperatures and the copious rainfalls over the principal grain-growing and grass-growing regions. The close of June marked the sixth consecutive week with the mean temperature below the normal over most northern and central districts. Only in the South Atlantic and Gulf States and along the immediate Pacific coast were the mean temperatures generally above the normal. Rain fell over practically every portion of the country save extreme southwestern Texas, the southern portions of New Mexico and Arizona, western Nevada, and the greater part of California. The rainfall was heavy in portions of the Mississippi and Missouri Valleys, the central and southern Plains States, and the southern part of the Florida Peninsula.

LOCAL STORMS.

The following notes on severe storms have been extracted from reports of the State section directors:

Colorado.—A severe wind and hail storm visited Brent and Powers counties on June 29. Two people were killed and 22 seriously injured. In a section of country 4 miles wide and 15 miles long destruction was complete. Loss about $10,000.

Illinois.—A severe wind, hail, and electric storm occurred during the night of June 20–21 in Green, Calhoun, Jersey, Macoupin, Montgomery, Bond, White, and Wabash counties, doing much damage to stock, crops, and other property. Loss probably exceeded $200,000.

South Dakota.—A tornado swept over a narrow path in Hughes, Hyde, and Hand counties on the afternoon of June 16, doing many thousand dollars' worth of damage

and seriously injuring a number of people. Also on June 22 a storm with heavy rain, hail, and high wind destroyed all crops over a path 2 to 3 miles wide along the Elk Creek Valley, Meade County. Estimated loss, $100,000.

Kansas.—Tornadoes occurred as follows: June 3, about 6 p. m., in Wichita County, one person killed and eight injured, loss about $40,000. June 11, about 6.30 p. m., in Kiowa, Pratt, Stafford, and Pawnee counties, loss from $50,000 to $75,000. June 17, three tornadoes occurred, one in Pottawatomie County at 4 p. m., five persons killed and three injured, loss about $5,000; one in Coffee County at 5 p. m., loss about $40,000; and one in Bourbon County about 9 p. m., five persons injured, loss about $50,000. June 23, at 3 p. m., in Grant County, no damage reported. June 30, in Crawford County, loss about $2,000. Loss from hail throughout the State estimated at over $1,000,000. [See page 288 for losses by flood.]

TORNADO OF MAY 20, 1915, IN SPRINGFIELD, MO.

The following extracts from notes of W. B. Hare, observer, Springfield, Mo., of a tornado at that place, are in addition to the May, 1915, report:

A storm, which for a quarter of a mile attained tornado intensity, passed over the southeastern part of Springfield at about 6:25 p. m., on May 20, 1915. The path of the storm was about 1 mile long and 100 yards wide. There was considerable destruction of property, but no serious injury to persons or live stock. The worst damage occurred about 1 mile east of the city limits. A long pencil-like cloud seemed to extend almost to the earth with winds whirling all around it, and as it began to move rather slowly toward the northeast the wind increased in force and a terrific roaring sound was heard. Heavy rain fell and lightning with heavy thunder was almost incessant during the passage of the tornado.

Probably the most striking evidence of the wind force characteristic of tornadoes was at the farm of W. B. Sanford, where an immense oak tree weighing several tons was lifted from the ground and hurled a distance of 20 feet, tearing the wing of a house from its foundation. The greatest damage at this farm was the uprooting or twisting of 200 fine oak trees. The storm proceeded northeastward from the Sanford farm and uprooted many trees in another grove. One large tree 6½ feet in circumference was split in two from a point 3 or 4 feet above the ground almost to the limbs. It was as if a mighty wedge had been forced through the tree trunk.

Average and accumulated departures for June, 1915.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	0-10.		P.ct.	
New England	61.6	−2.0	+ 8.7	1.94	−1.20	−4.50	5.9	+0.7	77	−2
Middle Atlantic	68.1	−2.1	+ 6.0	3.96	+0.30	−1.30	5.3	+0.3	73	0
South Atlantic	75.1	−1.0	− 2.0	3.99	−1.00	−2.90	4.8	−0.2	76	−2
Florida Peninsula	81.2	+0.8	−11.5	6.50	−0.30	+3.80	5.0	−0.2	76	−3
East Gulf	79.4	+1.3	− 3.9	4.48	−0.10	−2.40	4.3	−0.4	72	−3
West Gulf	80.1	+1.1	− 5.0	2.95	−0.80	−0.10	4.3	0.0	74	−2
Ohio Valley and Tennessee	70.9	−2.3	− 1.6	3.72	−0.50	−5.40	5.7	−0.7	72	+2
Lower Lakes	63.7	−3.3	+ 0.3	2.74	−0.80	−4.30	4.8	−0.1	70	−1
Upper Lakes	58.4	−4.2	+ 9.0	3.83	+0.50	−2.30	5.8	+0.7	74	0
North Dakota	57.6	−6.0	+17.3	5.25	+1.60	+0.20	5.6	+0.2	71	+3
Upper Mississippi Valley	67.0	−4.0	+ 5.2	4.60	+0.20	+0.80	5.8	+0.8	74	+4
Missouri Valley	66.7	−4.2	+ 1.9	5.92	+1.60	+4.50	5.6	+0.7	74	+7
Northern slope	56.8	−5.3	+ 6.5	3.66	+1.40	+1.60	5.6	+0.8	66	+9
Middle slope	68.2	−3.6	− 4.0	4.73	+1.60	+5.20	5.4	+1.4	69	+9
Southern slope	78.0	+0.8	− 8.9	1.16	−1.50	+2.00	2.9	−0.9	56	−4
Southern Plateau	73.7	−0.9	−14.1	0.18	−0.20	+1.60	1.7	−0.3	31	+1
Middle Plateau	63.2	−2.5	− 2.6	0.54	+0.10	+0.20	2.6	−0.7	26	−1
Northern Plateau	61.6	−3.4	+10.5	0.71	−0.40	+0.20	4.0	−0.6	48	−3
North Pacific	58.2	+0.6	+15.3	0.67	−1.40	−6.10	4.9	−1.2	76	−1
Middle Pacific	62.3	−0.3	+ 4.1	0.01	−0.40	+4.70	1.7	−1.6	58	−4
South Pacific	66.8	+0.6	+ 7.6	T.	−0.10	+3.90	2.5	−0.8	66	0

Maximum wind velocities, June, 1915.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Mi./hr.				Mi./hr.	
Abilene, Tex	25	54	sw.	New York, N. Y	27	60	e.
Buffalo, N. Y	7	52	sw.	Norfolk, Va	2	55	n.
Do	13	78	sw.	Oklahoma, Okla	24	74	n.
Chattanooga, Tenn.	11	60	sw.	Do	27	56	n.
Do	14	64	s.	Pensacola, Fla	25	54	nw.
Cheyenne, Wyo	12	52	w.	Pierre, S. Dak	27	57	n.
Columbus, Ohio	13	52	nw.	Pt. Reyes Light, Cal.	1	76	nw.
Dallas, Tex	13	53	s.	Do	2	50	nw.
Erie, Pa	13	53	w.	Do	9	69	nw.
Fort Smith, Ark	22	59	nw.	Do	10	81	nw.
Fort Worth, Tex	13	50	se.	Do	11	62	nw.
Do	14	52	se.	Do	15	59	nw.
Hannibal, Mo	18	50	se.	Do	18	57	nw.
Hatteras, N. C	3	55	n.	Do	19	62	nw.
Helena, Mont	25	54	sw.	Do	22	53	nw.
Kansas City, Mo	30	50	nw.	Do	24	51	nw.
Little Rock, Ark	22	62	nw.	Do	25	69	nw.
Louisville, Ky	20	56	nw.	Do	26	67	nw.
Mobile, Ala	28	51	n.	St. Paul, Minn.	12	54	se.
Mt. Tamalpais, Cal.	1	66	nw.	Sandy Hook, N. J	27	56	n.
Do	2	57	nw.	Sioux City, Iowa	15	50	s.
Do	3	53	n.	Valentine, Nebr	12	50	nw.
Do	9	63	nw.	Do	27	54	sw.
Do	10	88	nw.	Wichita, Kans	11	58	se.
Do	11	69	nw.	Do	17	62	w.
Do	15	63	nw.	Do	27	52	n.
Do	22	53	nw.				
Do	23	80	nw.				
Do	24	87	nw.				
Do	25	74	nw.				

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data, as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course the number of such records is smaller than the total number of stations.

Summary of temperature and precipitation, by sections, June, 1915.

Section.	Temperature.								Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	78.8	+0.8	2 stations	104	22	Florence	46	9	3.66	−0.80	Citronelle	7.77	Valley Head	1.32
Arizona	75.1	−0.7	Maricopa	115	22	Fort Valley	26	5	0.40	+0.04	Greer	2.50	17 stations	0.00
Arkansas	76.0	−0.4	Portland	106	21	2 stations	45	9	4.92	+0.77	Stuttgart	8.67	Hope	1.23
California	67.3	−1.7	Greenland Ranch	118	16	Macdoel	20	11	0.01	−0.30	Rohnersville	0.45	230 stations	0.00
Colorado	58.4	−2.9	2 stations	98	11†	2 stations	16	7†	1.71	+0.32	2 stations	5.38	2 stations	0.10
Florida	80.6	+0.9	De Funiak Springs	105	22	7 stations	60	5†	5.12	−2.31	Miami	15.83	Jacksonville	1.55
Georgia	77.8	0.0	Quitman	108	22	Blue Ridge	43	24	3.79	−0.96	Waynesboro	9.73	Fort Gaines	0.76
Hawaii (May)														
Idaho	57.0	−2.7	Glenns Ferry	100	24	Kilgore	21	26	0.97	−0.55	French Gulch	4.95	Glenns Ferry	0.00
Illinois	68.4	−3.0	2 stations	93	5†	Joliet	36	10	4.77	+0.71	Griggsville	14.77	Manteno	1.15
Indiana	68.4	−2.9	Connersville	97	7	8 stations	38	10	3.33	−0.62	Butlerville	7.15	Collegeville	0.68
Iowa	65.1	−4.0	Clarinda	91	25	Washta	31	9	4.16	−0.22	Keokuk	9.99	Jefferson	1.72
Kansas	69.2	−3.7	Ashland	99	17	Wallace	32	7	6.80	+2.59	Quenemo	13.91	Lakin	1.06
Kentucky	71.7	−2.2	Frankfort	95	28	Farmers	42	24	4.79	+0.57	Eubank	9.18	Blandville	1.99
Louisiana	81.9	+2.0	2 stations	105	21†	La Rose (near)	55	1	3.11	−2.08	Monroe	8.18	Houma	0.10
Maryland & Delaware	68.5	−1.5	Great Falls, Md	98	13	Deer Park, Md	31	10	5.07	+0.98	Millsboro, Del	7.97	Solomons, Md	1.53
Michigan	59.4	−4.3	Midland	92	7	3 stations	27	17†	3.78	+0.74	Seney	8.40	St. Joseph	1.46
Minnesota	59.4	−5.2	Waseca	96	5	Roseau	24	9	6.44	+2.35	Winnibigoshish	12.67	State Sanatorium	2.25
Mississippi	79.0	+0.3	5 stations	102	21†	Charleston	48	9	4.73	+0.22	Crenshaw	9.24	Hickory Flat	1.23
Missouri	70.8	−2.5	Sikeston	98	17†	Unionville	38	9	6.51	+1.87	Lamar	12.88	Sikeston	0.57
Montana	54.7	−4.7	Miles City	95	25	Bower	21	10	4.02	+1.21	Adel	12.03	Libby	0.96
Nebraska	64.2	−5.0	3 stations	92	5†	2 stations	30	7†	5.81	+1.92	Franklin	14.93	Hull	1.09
Nevada	63.3	−2.2	Logan	109	30	Tecoma	23	11	0.13	−0.32	Jack Creek	1.00	17 stations	0.00
New England	62.5	−2.2	2 stations	94	14†	3 stations	28	3	2.08	−1.07	Chestnut Hill, Mass.	5.42	Danielson, Conn	0.75
New Jersey	67.0	−2.3	Elizabeth	95	14	Culvers Lake	36	3	3.12	−0.72	Woodbine	6.51	Asbury Park	1.40
New Mexico	67.9	−1.4	Artesia	108	12†	2 stations	25	5†	0.55	−0.79	Hobbs	4.85	22 stations	0.00
New York	63.1	−1.7	Brockport	94	13	3 stations	30	4†	3.33	−0.16	Cooperstown	7.15	Hoosick Falls	1.04
North Carolina	71.6	−1.9	Tarboro	99	14	Banners Elk	37	24	4.45	−0.84	Rock House	17.78	2 stations	1.51
North Dakota	56.7	−6.4	Buford	94	2	McKinney	20	16	5.00	+1.56	Aplin	10.56	Buford	1.01
Ohio	66.8	−2.5	Summerfield	96	17	Green Hill	31	24	4.36	+0.68	Upper Sandusky	10.25	Case School (Cleveland).	1.73
Oklahoma	74.2	−2.0	Eldorado	108	19	Hurley	35	6	7.12	+3.44	Pauls Valley	14.04	Woodward	2.87
Oregon	59.6	+0.3	2 stations	102	30	Whittaker	18	18	0.70	−0.68	Headworks	5.48	6 stations	0.00
Pennsylvania	65.6	−2.2	2 stations	92	12†	West Bingham	31	4	4.00	+0.05	Beaver Dam	6.80	Mount Pocono	1.51
Porto Rico	79.1	+0.8	2 stations	99	8†	Maricao	55	1†	8.19	+1.24	RioGrande(ElVerde)	31.30	Arecibo	1.25
South Carolina	76.0	−1.6	Camden	103	22	Society Hill	49	1	4.26	−0.77	Blackville	9.68	Bowman	1.24
South Dakota	60.4	−5.3	3 stations	89	23†	Goldfield	24	8	5.34	+1.66	Aberdeen	9.12	Faith	2.11
Tennessee	73.6	−0.4	Brownsville	100	20	2 stations	40	9†	3.73	−1.11	Rugby	12.75	Waynesboro	0.70
Texas	81.2	+1.4	Fort Stockton	113	19	Romero	39	7	2.24	−0.78	Paris	10.00	27 stations	0.00
Utah	60.8	−3.8	Woodside	108	21†	Scofield	19	15	0.73	+0.22	Utah Exp. Station	1.94	St. George	0.00
Virginia	69.4	−2.0	2 stations	95	13	Burkes Garden	31	24	4.84	+0.29	Newport News	9.57	Burkes Garden	1.83
Washington	60.6	+0.3	White Salmon	101	30	Mold	28	16	0.79	−0.91	Washougal	3.43	Gold Creek	0.00
West Virginia	67.7	−1.8	2 stations	95	13†	Bayard	33	24	3.63	−0.88	Beckley	7.09	Bluefield	1.21
Wisconsin	59.8	−5.0	Osceola	94	27	Koepenick	28	8†	3.74	−0.11	Hayward	7.76	Prairie du Sac	1.43
Wyoming	52.2	−4.8	Worland	93	25†	Lake Yellowstone	15	5†	3.02	+1.25	Knowles	8.31	Foxpark	0.79

† Other dates also.

DESCRIPTION OF TABLES AND CHARTS.

Table I gives the data ordinarily needed for climatological studies for about 158 Weather Bureau stations making simultaneous observations at 8 a. m. and 8 p. m., daily, seventy-fifth meridian time, and for about 41 others making only one observation. The altitudes of the instruments above ground are also given.

Table II gives a record of precipitation, the intensity of which at some period of the storm's continuance equaled or exceeded the following rates:

Duration (minutes)	5	10	15	20	25	30	35	40	45	50	60
Rates per hour (inches)........	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.87	0.84	0.80

It is impracticable to make this table sufficiently wide to accommodate on one line the record of accumulated falls that continue at an excessive rate for several hours. In this case *the record is broken at the end of each 50 minutes*, the accumulated amounts being recorded on successive lines until the excessive rate ends.

In cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest precipitation of any single storm has been given, also the greatest hourly fall during that storm.

The tipping-bucket mechanism is *dismounted* and removed when there is danger of snow or water freezing in the same. Table II records this condition by entering an asterisk (*).

Table III gives, for about 30 stations of the Canadian Meteorological Service, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values except in the case of snowfall.

Chart I.—Hydrographs for several of the principal rivers of the United States.

Chart II.—Tracks of centers of high areas; and

Chart III.—Tracks of centers of low areas. The roman numerals show the chronological order of the centers. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the observations at 8 a. m. and 8 p. m., seventy-fifth meridian time. Within each circle is also given (Chart II) the last three figures of the highest barometric reading and (Chart III) the lowest reading reported at or near the center at that time, and in both cases as reduced to sea level and standard gravity.

Chart IV.—Temperature departures. This chart presents the departures of the monthly mean temperatures from the monthly normals. The normals used in computing the departures were computed for a period of 33 years (1873 to 1905) and are published in Weather Bureau Bulletin "R," Washington, 1908. Stations whose records were too short to justify the preparation of normals in 1908 have been provided with normals as adequate records became available and all have been reduced to the 33-year interval 1873–1905. The shaded portions of the chart indicate areas of positive departures and unshaded portions indicate areas of negative departures. Generalized lines connect places having approximately equal departures of like sign. This chart of monthly temperature departures in the United States was first published in the MONTHLY WEATHER REVIEW for July, 1909.

Chart V.—Total precipitation. The scale of shades showing the depth is given on the chart. Where the monthly amounts are too small to justify shading, and over sections of the country where stations are too widely separated or the topography is too diversified to warrant reasonable accuracy in shading, the actual depths are given for a limited number of representative stations. Amounts less than 0.005 inch are indicated by the letter T, and no precipitation by 0.

Chart VI.—Percentage of clear sky between sunrise and sunset. The average cloudiness at each Weather Bureau station is determined by numerous personal observations between sunrise and sunset. The difference between the observed cloudiness and 100 is assumed to represent the percentage of clear sky, and the values thus obtained are the basis of this chart. The chart does not relate to the nighttime.

Chart VII.—Isobars and isotherms at sea level and prevailing wind directions. The pressures have been reduced to sea level and standard gravity by the method described by Prof. Frank H. Bigelow on pages 13–16 of the REVIEW for January, 1902. The pressures have also been reduced to the mean of the 24 hours by the application of a suitable correction to the mean of the 8 a. m. and 8 p. m. readings at stations taking two observations daily, and to the 8 a. m. or the 8 p. m. observation, respectively, at stations taking but a single observation. The diurnal corrections so applied will be found in the Annual Report of the Chief of the Weather Bureau, 1900–1901, volume 2, Table 27, pages 140–164.

The isotherms on the sea-level plane have been constructed by means of the data summarized in chapter 8 of volume 2 of the annual report just mentioned. The correction t_0-t, or temperature on the sea-level plane minus the station temperature as given by Table 48 of that report, is added to the observed surface temperature to obtain the adopted sea-level temperature.

The prevailing wind directions are determined from hourly observations at the great majority of the stations; a few stations having no self-recording wind-direction apparatus determine the prevailing direction from the daily or twice-daily observations only.

Chart VIII.—Total snowfall. This is based on the reports from regular and cooperative observers and shows the depth in inches and tenths of the snowfall during the month. In general, the depth is shown by lines inclosing areas of equal snowfall, but in special cases figures are also given. Chart VIII is published only when the general snow cover is sufficiently extensive to justify its preparation.

TABLE I.—*Climatological data for United States Weather Bureau stations, June, 1915.*

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Precipitation.			Wind.										
	Barometer above sea level.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity, per cent.	Total.	Departure from normal.	Days with 0.01 or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F	°F	°F		°F	°F		°F	°F	°F	°F		In.	In.		Miles								0–10		
New England.							**61.6**	**- 2.0**										**77**	**1.94**	**- 1.2**										**5.9**		
Eastport	76	67	85	29.94	30.02	+0.09	53.2	- 1.2	72	1	61	37	3	46	26	49	45	79	3.45	+ 0.2	16	5,715	s.	40	ne.	2	5	7	18	7.3	...	...
Greenville	1,070	6	...	28.86	30.02	...	58.8	...	81	5	71	33	3	46	45	...	...	...	2.00	...	12	...	...	...	...	...	...	...	...	...	...	...
Portland, Me.	103	82	117	29.92	30.04	+ .09	59.2	- 3.4	86	29	68	38	3	51	32	54	49	71	1.72	- 1.6	13	5,483	e.	34	ne.	2	8	12	10	5.8	...	...
Concord	288	70	79	29.72	30.03	+ .07	62.0	- 2.4	87	14	74	32	3	50	41	...	...	...	1.37	- 2.0	10	3,488	n.	21	n.	23	10	12	8	5.0	...	...
Burlington	404	11	48	29.58	30.01	+ .05	62.6	- 1.2	84	5	74	42	3	52	34	...	...	...	2.18	- 1.1	7	6,589	s.	43	s.	19	8	15	7	5.4	...	...
Northfield	876	12	60	29.09	30.03	+ .07	58.4	- 4.3	81	5	72	31	3	45	42	55	51	73	3.16	- 0.1	9	4,988	s.	33	s.	19	6	12	12	6.2	...	...
Boston	125	115	188	29.89	30.02	+ .06	63.9	- 1.9	87	29	71	44	3	56	25	58	54	74	1.39	- 1.6	7	6,314	e.	30	e.	2	5	19	6	5.4	...	...
Nantucket	12	14	90	30.00	30.01	+ .03	61.0	- 0.3	77	29	68	45	2	55	19	57	55	87	1.31	- 1.1	7	10,018	sw.	41	ne.	3	10	14	6	5.3	...	...
Block Island	26	11	46	29.98	30.01	+ .04	61.1	- 0.5	75	29	67	47	2	55	18	58	57	90	1.00	- 1.9	6	10,369	sw.	41	e.	2	9	6	15	6.5	...	...
Narragansett Pier	...	9	...	...	...	...	61.9	- 2.3	83	12	70	45	3	54	26	...	...	...	2.03	...	8	...	sw.	...	...	...	14	10	6	...	...	...
Providence	160	215	251	29.84	30.01	+ .04	64.1	- 4.2	85	29	74	42	2	55	26	58	54	72	1.29	- 1.8	10	7,863	nw.	37	w.	12	7	17	6	5.7	...	...
Hartford	159	122	140	29.84	30.01	+ .04	66.0	- 1.1	88	14	76	43	3	56	31	58	53	69	1.51	- 1.6	13	5,227	s.	30	sw.	11	6	12	12	6.2	...	...
New Haven	106	117	155	29.90	30.01	+ .04	66.0	- 0.9	87	14	75	45	3	57	29	60	56	74	2.94	- 0.2	15	6,377	n.	27	n.	6	9	11	10	5.9	...	...
Middle Atlantic States.							**68.1**	**- 2.1**										**73**	**3.96**	**+ 0.3**										**5.3**		
Albany	97	102	115	29.90	30.00	+ .03	66.2	- 1.7	85	14	77	43	3	50	36	58	52	62	2.85	- 0.9	9	5,171	s.	36	nw.	27	12	13	5	4.5	...	...
Binghamton	871	10	69	29.10	30.02	+ .05	64.6	- 1.6	88	18	76	43	9	53	38	...	...	...	5.37	+ 1.8	10	3,385	nw.	24	s.	19	8	16	6	5.2	...	...
New York	314	414	454	29.68	30.01	+ .03	66.6	- 1.9	89	14	74	46	3	59	27	59	55	71	3.66	+ 0.4	12	9,621	ne.	60	e.	27	8	7	15	6.3	...	...
Harrisburg	374	94	104	29.62	30.02	+ .03	68.4	- 1.9	88	14	78	46	3	59	28	60	55	65	3.51	0.0	10	4,528	s.	33	w.	11	10	12	8	5.3	...	...
Philadelphia	117	123	190	29.90	30.02	+ .04	69.6	- 1.6	89	15	78	48	3	61	22	63	58	71	3.45	+ 0.2	8	7,213	ne.	31	ne.	27	8	14	8	5.5	...	...
Reading	325	81	98	29.67	30.01	...	68.4	...	89	15	78	47	3	59	29	61	56	68	2.84	- 0.8	10	4,639	se.	38	sw.	15	6	10	14	6.3	...	...
Scranton	805	111	119	29.18	30.02	+ .04	65.8	- 1.4	86	15	76	45	3	56	32	58	53	66	3.27	- 0.3	10	4,464	n.	32	sw.	19	6	12	12	5.9	...	...
Atlantic City	52	37	48	29.96	30.02	+ .04	64.6	- 2.2	80	14	70	51	1	59	23	61	58	83	2.40	- 0.6	13	6,546	s.	32	ne.	3	9	8	13	6.2	...	...
Cape May	18	13	49	30.02	30.04	+ .06	65.6	- 2.1	85	14	72	50	1	59	23	...	...	...	3.84	+ 0.8	12	6,091	s.	28	ne.	2	13	10	7	4.8	...	...
Sandy Hook	22	10	57	29.99	30.01	...	65.6	...	85	12	72	48	3	59	23	62	61	90	3.62	...	13	9,568	s.	56	n.	27	8	10	12	5.9	...	...
Trenton	190	150	183	29.80	30.00	...	67.8	...	89	15	77	46	3	59	26	61	57	72	2.07	- 1.4	11	7,645	ne.	37	ne.	3	6	10	14	6.4	...	...
Baltimore	123	100	113	29.88	30.01	+ .02	70.6	- 2.4	90	15	79	48	3	62	24	63	59	70	6.23	+ 2.4	11	5,083	se.	26	n.	13	9	15	6	5.3	...	...
Washington	112	62	85	29.88	30.00	.00	70.6	- 2.1	92	15	80	49	1	61	30	63	59	70	6.58	+ 2.4	14	4,468	s.	34	nw.	15	11	12	7	5.0	...	...
Lynchburg	681	153	188	29.26	30.00	- .01	71.6	- 1.9	93	13	82	49	1	61	33	65	62	75	4.16	+ 0.3	8	4,550	ne.	27	nw.	15	12	10	8	5.0	...	...
Norfolk	91	170	205	29.91	30.00	.00	71.3	- 3.1	91	13	78	55	3	64	24	65	62	76	6.52	+ 2.2	13	9,200	n.	55	n.	2	14	7	9	5.0	...	...
Richmond	144	11	52	29.86	30.01	.00	72.0	- 3.1	92	14	81	52	1	63	31	65	61	74	3.77	+ 0.2	8	5,358	ne.	23	nw.	23	12	12	6	4.6	...	...
Wytheville	2,293	40	47	27.68	30.00	- .01	66.4	- 2.3	85	13	77	43	24	56	34	60	57	77	2.87	- 1.2	13	2,837	w.	22	w.	21	18	8	4	3.2	...	...
South Atlantic States.							**75.1**	**- 1.0**										**76**	**3.99**	**- 1.0**										**4.8**		
Asheville	2,255	70	84	27.71	30.01	.00	67.6	- 1.1	87	11	77	49	10	58	33	62	59	80	4.74	+ 0.4	17	4,532	nw.	28	w.	15	10	13	7	5.2	...	...
Charlotte	773	153	161	29.18	30.00	- .01	73.1	- 2.4	91	14	82	52	2	64	24	65	61	72	5.45	+ 1.0	9	6,061	ne.	39	w.	15	7	13	10	5.8	...	...
Hatteras	11	12	50	29.97	29.98	- .03	71.6	- 2.8	84	22	76	57	6	67	14	68	66	83	4.62	+ 0.3	10	10,205	sw.	55	n.	3	12	7	11	5.6	...	...
Manteo	12	4	46	...	...	...	70.8	...	90	15	78	54	4	63	...	...	...	...	5.04	+ 0.7	5	...	sw.	...	...	...	18	5	7	...	...	...
Raleigh	376	103	110	29.60	29.99	- .02	73.2	- 1.9	93	14	82	54	4	64	26	65	61	70	3.25	- 1.5	9	5,020	ne.	25	w.	30	15	9	6	4.6	...	...
Wilmington	78	81	91	29.92	30.00	- .01	75.1	- 0.4	94	21	83	57	4	67	24	69	66	78	2.28	- 3.3	11	5,161	sw.	28	ne.	21	9	15	6	5.0	...	...
Charleston	48	11	92	29.94	29.99	- .02	78.0	- 0.5	93	20	85	60	4	72	20	71	68	74	4.52	- 0.9	7	6,811	s.	29	e.	29	19	6	5	3.7	...	...
Columbia, S. C.	351	41	57	29.63	30.00	- .01	76.2	- 2.0	97	22	86	56	4	66	26	68	64	73	3.74	- 0.4	11	3,966	ne.	28	se.	11	11	14	5	4.2	...	...
Augusta	180	89	97	29.81	30.00	- .01	77.5	- 0.6	98	21	87	59	2	68	26	69	65	72	4.25	- 0.3	11	3,683	ne.	29	nw.	15	12	12	6	4.8	...	...
Savannah	65	150	194	29.92	29.99	- .02	79.0	+ 0.8	97	22	88	64	6	70	25	73	70	80	4.49	- 1.5	11	6,697	s.	32	s.	15	17	7	6	4.2	...	...
Jacksonville	43	200	245	29.94	29.99	- .02	79.8	+ 0.8	98	22	88	67	5	72	24	72	70	78	1.55	- 4.0	6	7,594	se.	40	w.	28	10	15	5	5.1	...	...
Florida Peninsula.							**81.2**	**+ 0.8**										**76**	**6.50**	**- 0.3**										**5.0**		
Key West	22	10	64	29.93	29.95	- .04	82.6	+ 0.4	91	28	88	72	16	77	13	76	73	74	3.05	- 1.2	10	5,838	e.	29	w.	1	13	11	6	4.8	...	...
Miami	25	71	79	29.94	29.98	...	79.4	- 1.0	89	23	85	68	7	74	15	74	72	78	12.53	+ 4.6	11	6,134	e.	40	e.	17	10	7	13	5.8	...	...
Sand Key	23	39	72	29.91	29.94	- .05	81.5	...	90	26	84	73	1	79	11	77	75	80	3.07	...	9	7,313	e.	44	e.	15	14	10	6	4.5	...	...
Tampa	35	79	96	29.94	29.97	- .04	81.6	+ 2.9	93	14	89	60	6	74	20	73	71	73	3.93	- 4.4	8	4,755	ne.	32	nw.	10	9	17	4	5.1	...	...
East Gulf States.							**79.4**	**+ 1.3**										**72**	**4.48**	**- 0.1**										**4.3**		
Atlanta	1,174	190	216	28.80	30.01	.00	75.3	- 0.3	93	20	85	57	1	66	24	67	63	72	3.82	- 0.1	11	6,141	nw.	37	se.	16	11	8	11	5.2	...	...
Macon	370	78	87	29.59	29.98	- .03	79.2	+ 2.1	98	21	89	61	10	69	31	70	65	66	1.87	- 1.7	9	3,523	nw.	27	n.	16	13	10	7	4.4	...	...
Thomasville	273	8	57	29.68	29.97	- .03	81.1	+ 1.6	104	22	93	63	10	69	31	72	69	76	4.15	- 0.6	7	2,904	nw.	32	sw.	23	15	8	7	4.2	...	...
Pensacola	56	140	182	29.92	29.98	- .01	81.2	+ 1.2	97	22	88	65	25	74	21	74	71	74	5.34	+ 0.5	9	7,302	sw.	54	nw.	25	13	11	6	4.6	...	...
Anniston	741	9	57	29.23	30.01	+ .01	76.4	+ 1.4	96	20	87	54	24	65	35	...	...	...	1.66	- 2.2	12	3,000	se.	28	sw.	11	13	13	4	3.8	...	...
Birmingham	700	11	48	29.25	30.00	+ .01	77.4	- 0.8	94	21	87	57	9	68	27	68	64	69	4.80	+ 0.9	11	3,588	s.	34	nw.	22	8	11	11	5.2	...	...
Mobile	57	125	161	29.92	29.98	- .01	81.6	+ 2.5	99	22	90	66	1	73	24	73	70	73	7.41	+ 1.5	11	5,884	sw.	51	n.	28	17	10	3	3.8	...	...
Montgomery	223	100	112	29.74	29.98	- .02	80.4	+ 1.3	100	22	91	62	10	70	31	70	66	67	2.33	- 1.9	8	3,733	se.	33	sw.	11	16	10	4	3.5	...	...
Meridian	375	85	93	29.59	29.98	.00	78.4	+ 1.1	100	22	89	60	10	68	32	71	68	73	5.96	+ 1.3	10	2,944	w.	40	nw.	22	16	4	10	4.5	...	...
Vicksburg	247	65	74	29.72	29.99	+ .02	79.0	+ 0.5	96	22	88	64	2	70	27	72	69	77	6.31	+ 1.8	10	3,979	sw.	34	nw.	22	14	14	2	3.9	...	...
New Orleans	51	76	84	29.92	29.97	- .01	83.8	+ 4.2	102	22	92	67	2	75	24	75	71	71	5.61	- 0.6	8	3,751	sw.	23	se.	14	14	12	4	3.9	...	...
West Gulf States.							**80.1**	**+ 1.1**										**74**	**2.95**	**- 0.8**										**4.3**		
Shreveport	249	77	93	29.69	29.96	.00	80.7	+ 1.1	99	22	90	66	9	71	26	72	69	74	3.10	- 0.5	7	5,015	s.	31	n.	27	14	10	6	4.5	...	...
Bentonville	1,303	11	44	28.58	29.93	- .01	71.4	- 2.7	91	20	80	52	8	62	28	...	...	...	8.61	+ 4.0	13	3,335	s.	21	s.	22	6	15	9	6.2	...	...
Fort Smith	457	79	94	29.45	29.92	- .02	76.0	- 0.8	96	20	85	58	8	67	27	69	66	72	5.20	+ 1.2	14	4,900	e.	59	nw.	22	10	9	11	5.2	...	...
Little Rock	357	139	147	29.58	29.95	- .01	76.2	- 1.0	98	21	85	60	9	68	25	70	67	77	3.72	- 0.4	9	5,597	s.	62	nw.	22	11	11	8	5.1	...	...
Brownsville	57	3	40	...	...	...	84.4	...	97	22	93	68	1	75	22	...	...	...	T.	...	0	...	s.	...	...	...	...	...	...	...	...	...
Corpus Christi	20	69	77	29.91	29.93	+ .02	82.4	+ 1.8	91	30	87	68	1	78	18	77	75	83	T.	- 2.7	0	12,177	se.	35	se.	28	15	14	1	3.9	...	...
Dallas	512	109	117	29.38	29.92	...	80.3	...	99	21	90	59	1	71	26	...	...	...	6.45	...	8	7,866	se.	53	s.	13	12	13	5	4.7	...	...
Fort Worth	670	106	114	29.19	29.89	- .03	80.3	+ 0.2	100	28	90	61	2	70	27	70	66	67	6.88	+ 3.9	8	8,212	s.	52	se.	14	10	10	10	5.0	...	...
Galveston	54	106	114	29.91	29.97	+ .02	82.6	+ 1.7	88	23	86	71	1	79	12	76	74	77	0.08	- 4.7	1	8,411	s.	25	s.	15	27	3	0	2.1	...	...
Houston	138	111	121	29.81	29.95	...	83.7	+ 2.7	98	23	94	66	1	74	25	...	...	...	0.39	...	2	5,874	s.	25	se.	25	15	15	0	3.1	...	...
Palestine	510	64	72	29.40	29.92	- .02	81.3	+ 2.9	95	22	90	64	2	72	24	74	72	79	1.52	- 2.5	2	5,293	s.	20	n.	15	18	8	4	3.8	...	...
San Antonio	701	109	132	29.18	29.89	- .01	83.8	+ 3.4	101	29	94	62	1	73	28	73	68	66	0.03	- 3.1	1	6,901	sw.	26	s.	26	13	17	0	3.8	...	...
Taylor	582	55	63	29.35	29.96	+ .04	82.6	+ 2.6	99	29	93	60	1	72	26	...	...	...	0.32	- 3.2	3	8,315	s.	27	s.	19	13	16	1	4.0	...	...

TABLE I.—*Climatological data for United States Weather Bureau stations, June, 1915*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Precipitation.			Wind.										
	Barometer above sea level.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity, per cent.	Total.	Departure from normal.	Days with 0.01 or more.	Total movement.	Prevailing direction.	Maximum velocity: Miles per hour.	Maximum velocity: Direction.	Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F	°F	°F		°F	°F		°F	°F	°F	°F		In.	In.		Miles								0-10		
Ohio Valley and Tennessee.							**70.9**	**− 2.3**										**72**	**3.72**	**− 0.5**										**5.7**		
Chattanooga	762	189	213	29.21	30.01	+0.01	74.6	− 0.8	94	20	84	56	9	66	26	66	63	71	2.74	− 1.6	10	4,617	s.	64	s.	14	7	15	8	5.4	......	....
Knoxville	996	93	100	28.96	30.00	.00	72.6	− 0.8	89	20	82	54	24	63	28	66	63	75	6.24	+ 2.1	16	2,729	ne.	27	nw.	21	3	11	16	6.9	......	....
Memphis	399	76	97	29.57	29.99	+ .02	76.6	− 1.1	92	21	85	61	8	69	21	69	65	71	1.72	− 2.6	8	5,120	sw.	42	nw.	11	11	12	7	5.0	......	....
Nashville	546	168	191	29.42	30.00	+ .01	74.6	− 1.7	93	20	84	52	9	65	28	67	63	72	1.42	− 3.0	12	5,253	w.	46	nw.	13	4	16	10	5.9	......	....
Lexington	989	75	102	28.92	29.97	− .03	70.2	− 3.0	86	26	79	51	9	61	26	......	......	......	3.20	− 0.8	13	5,652	s.	36	w.	13	10	11	9	5.2	......	....
Louisville	525	219	255	29.41	29.99	+ .01	72.6	− 2.4	88	26	82	54	8	64	26	66	64	77	3.11	− 1.1	12	6,226	nw.	56	nw.	20	5	13	12	6.8	......	....
Evansville	431	72	82	29.50	29.96	− .01	73.2	− 2.1	91	6	82	52	8	65	25	67	64	76	3.69	− 0.5	12	3,935	nw.	49	n.	21	4	15	11	6.4	......	....
Indianapolis	822	154	164	29.11	29.98	+ .01	69.5	− 2.9	87	28	79	48	10	60	27	62	58	69	2.91	− 1.4	11	5,954	sw.	42	sw.	13	8	14	8	5.7	......	....
Terre Haute	575	96	129	29.34	29.95	......	70.5	......	88	6	80	49	8	61	28	64	60	71	2.22	......	10	5,767	nw.	45	w.	13	3	20	7	6.2	......	....
Cincinnati	628	11	51	29.31	29.98	− .01	69.3	− 4.4	87	13	79	48	10	60	28	63	59	73	4.47	+ 0.5	11	3,642	ne.	37	nw.	13	9	11	10	5.7	......	....
Columbus	824	173	222	29.13	30.00	+ .01	68.0	− 3.0	87	13	77	48	10	59	31	61	58	73	5.06	+ 1.6	13	6,545	se.	52	nw.	13	12	12	6	4.4	......	....
Dayton	899	181	216	29.02	29.96	......	68.6	− 3.6	88	13	78	48	10	59	28	62	58	73	4.35	+ 0.4	12	5,653	nw.	46	w.	13	11	13	6	4.7	......	....
Pittsburgh	842	353	410	29.11	30.00	+ .01	67.1	− 4.0	87	18	76	44	24	58	28	59	54	63	5.36	+ 1.5	12	7,180	nw.	43	nw.	13	9	8	13	5.5	......	....
Elkins	1,940	41	50	28.00	30.01	+ .01	65.6	− 1.0	89	13	78	37	24	54	40	58	55	74	2.45	− 2.6	13	2,563	w.	22	w.	11	5	17	8	6.1	......	....
Parkersburg	638	77	84	29.36	30.02	+ .02	69.6	− 1.9	89	13	80	47	24	60	29	63	59	75	4.84	+ 0.2	11	3,256	se.	40	nw.	13	11	10	9	5.2	......	....
Lower Lake Region.							**63.7**	**− 3.3**										**70**	**2.74**	**− 0.8**										**4.8**		
Buffalo	767	247	280	29.18	30.00	+ .03	64.0	− 1.1	90	18	73	46	24	55	35	57	51	66	1.72	− 1.4	11	9,498	sw.	78	sw.	13	12	11	7	5.0	......	....
Canton	448	10	61	29.54	30.00	......	63.0	− 2.8	87	7	75	43	9	52	40	......	......	......	3.67	+ 0.2	13	6,086	w.	41	sw.	19	20	6	4	3.5	......	....
Oswego	335	76	91	29.64	30.00	+ .03	60.4	− 3.4	84	7	70	44	10	51	32	55	51	71	2.58	− 0.8	10	5,757	w.	30	w.	15	14	8	8	4.5	......	....
Rochester	523	97	113	29.45	30.02	+ .05	64.0	− 2.1	89	13	74	46	24	54	33	56	49	60	2.29	− 0.8	10	5,322	w.	36	w.	19	14	8	8	4.8	......	....
Syracuse	597	97	113	29.39	30.03	+ .06	63.2	− 3.7	84	18	74	45	4	53	33	56	50	63	3.47	− 0.4	9	6,924	s.	40	sw.	15	13	7	10	4.8	......	....
Erie	714	130	166	29.24	30.00	+ .02	64.2	− 2.8	88	18	72	47	9	56	28	58	54	71	2.57	− 1.2	11	8,639	se.	53	w.	13	10	13	7	5.0	......	....
Cleveland	762	190	201	29.19	30.00	+ .02	63.9	− 4.0	87	13	71	44	24	57	27	58	54	72	2.03	− 1.6	12	8,580	se.	47	s.	18	11	12	7	4.7	......	....
Sandusky	629	62	103	29.32	30.00	+ .02	64.9	− 3.8	88	13	72	48	24	58	27	59	55	73	3.48	− 0.3	9	7,677	e.	40	w.	13	9	13	8	5.0	......	....
Toledo	628	208	243	29.32	30.00	+ .03	64.8	− 4.6	85	13	73	48	8	56	27	59	55	74	1.85	− 1.5	10	9,286	ne.	48	nw.	7	14	11	5	4.1	......	....
Fort Wayne	856	113	124	29.09	30.00	......	64.8	− 3.7	84	6	74	43	10	55	29	59	56	74	2.77	......	12	5.802	ne.	36	sw.	18	6	12	12	6.1	......	....
Detroit	730	218	245	29.22	30.01	+ .04	63.1	− 4.7	86	13	72	46	23	54	31	57	52	71	3.71	− 0.2	15	8,166	e.	48	w.	7	7	18	5	5.0	......	....
Upper Lake Region.							**58.4**	**− 4.2**										**74**	**3.83**	**+ 0.5**										**5.8**		
Alpena	609	13	92	29.34	30.01	+ .05	56.0	− 4.3	85	13	64	39	10	48	34	53	49	75	5.24	+ 1.7	13	7,896	se.	48	se.	18	6	18	6	5.5	......	....
Escanaba	612	54	60	29.32	29.98	+ .04	56.8	− 3.8	76	2	64	38	23	49	25	52	48	72	3.43	− 0.2	12	6,598	s.	40	ne.	18	9	15	6	5.2	......	....
Grand Haven	632	54	92	29.31	29.98	+ .02	60.3	− 4.4	83	28	69	38	10	51	32	55	51	73	2.84	+ 0.3	11	6,790	w.	36	sw.	12	14	8	8	4.6	......	....
Grand Rapids	707	70	87	29.23	30.00	+ .03	63.4	− 4.7	88	6	74	41	10	53	28	57	52	68	1.86	− 0.7	12	4,395	se.	28	w.	12	3	16	11	6.6	......	....
Houghton	684	62	72	29.23	29.96	+ .02	54.6	− 4.8	82	27	64	37	8	45	33	......	......	......	4.37	+ 0.9	11	6,316	se.	31	w.	16	9	9	12	5.6	......	....
Lansing	878	11	62	29.05	29.99	......	61.0	− 6.4	84	6	73	39	10	49	34	57	53	76	3.96	+ 0.6	15	3,767	se.	20	w.	13	7	13	10	6.0	......	....
Ludington	637	60	66	29.29	29.98	......	57.7	......	79	27	67	38	10	49	26	54	50	76	2.54	......	11	6,153	e.	35	s.	18	9	11	10	5.8	......	....
Marquette	734	77	111	29.20	30.01	+ .07	55.2	− 3.3	87	27	64	39	23	47	32	50	46	74	5.13	+ 1.6	13	6,351	e.	40	sw.	13	4	11	15	7.1	......	....
Port Huron	638	70	120	29.31	30.00	+ .03	59.7	− 4.1	84	13	69	43	10	51	31	54	51	74	4.10	+ 0.9	14	7,242	ne.	36	nw.	22	10	18	2	4.7	......	....
Saginaw	641	48	82	29.31	30.00	......	61.5	......	86	6	72	40	23	51	31	56	53	74	4.75	+ 2.1	14	6,197	e.	44	s.	18	8	11	11	6.0	......	....
Sault Ste. Marie	614	11	61	29.32	30.02	+ .06	55.5	− 2.1	82	28	66	37	10	45	33	50	46	74	3.75	+ 1.0	16	6,127	se.	42	nw.	22	5	9	16	6.8	......	....
Chicago	823	140	310	29.11	29.99	+ .03	63.8	− 2.5	88	6	71	46	9	57	28	57	53	72	3.60	− 0.1	12	7,794	n.	38	s.	18	9	12	9	5.3	......	....
Green Bay	617	109	144	29.31	29.96	+ .01	60.1	− 5.0	83	29	69	40	9	51	24	56	52	75	2.54	− 1.0	12	7,550	se.	37	se.	12	5	18	7	6.3	......	....
Milwaukee	681	119	133	29.25	29.98	+ .03	59.3	− 4.2	84	6	67	42	9	51	28	54	50	74	3.11	− 0.6	10	6,163	ne.	32	se.	18	3	20	7	6.0	......	....
Duluth	1,133	11	47	28.76	29.98	+ .06	53.2	− 4.5	78	28	62	34	9	44	29	50	47	79	4.96	+ 0.4	16	8,423	ne.	47	w.	28	7	15	8	5.4	......	....
North Dakota.							**57.6**	**− 6.0**										**71**	**5.25**	**+ 1.6**										**5.6**		
Moorhead	940	8	57	28.94	29.95	+ .05	59.2	− 5.1	82	26	70	32	9	48	31	55	52	77	9.13	+ 5.0	21	6,023	se.	45	nw.	26	12	12	6	4.3	......	....
Bismarck	1,674	8	57	28.19	29.96	+ .09	58.2	− 6.0	86	25	69	33	8	47	37	52	47	71	5.70	+ 2.2	12	7,740	nw.	34	w.	26	9	12	9	5.6	......	....
Devils Lake	1,482	11	44	28.35	29.92	+ .04	55.4	− 7.2	79	3	66	33	7	45	34	51	46	72	4.53	+ 1.0	14	7,600	se.	40	ne.	12	2	15	13	6.7	......	....
Williston	1,872	40	47	27.94	29.91	+ .05	57.6	− 5.9	85	24	69	30	16	46	37	50	43	63	1.64	− 1.9	10	6,868	nw.	41	nw.	20	8	13	9	5.9	......	....
Upper Mississippi Valley.							**67.0**	**− 4.0**										**74**	**4.60**	**+ 0.2**										**5.8**		
Minneapolis	918	10	208	28.97	29.94	......	62.5	......	85	27	71	39	9	54	27	......	......	......	4.91	+ 0.9	15	8,361	w.	40	se.	12	4	13	13	6.9	......	....
St. Paul	837	201	236	29.03	29.94	+ .02	62.4	− 5.0	85	27	71	38	9	54	25	......	......	......	3.58	− 0.8	14	8,668	se.	54	se.	12	3	19	8	6.2	......	....
La Crosse	714	11	48	29.19	29.96	+ .03	63.1	− 5.1	86	27	73	41	9	53	32	......	......	......	3.91	− 0.5	11	3,385	nw.	18	nw.	8	7	9	14	6.4	......	....
Madison	974	70	78	28.95	29.98	+ .04	62.0	− 5.3	84	27	71	40	9	52	28	56	52	72	1.75	− 2.4	11	5,861	se.	27	sw.	16	2	15	13	6.9	......	....
Charles City	1,015	10	49	28.90	29.96	+ .05	62.4	− 6.4	86	27	73	37	9	52	31	59	57	80	3.74	− 1.4	16	4,412	se.	27	se.	12	10	14	6	5.1	......	....
Davenport	606	71	79	29.30	29.96	+ .02	66.6	− 4.3	88	27	77	43	9	57	30	61	57	75	3.47	− 0.6	10	5,194	e.	29	w.	12	9	13	8	5.4	......	....
Des Moines	861	84	97	29.05	29.94	+ .02	67.0	− 3.4	86	12	76	45	9	58	26	61	56	70	3.60	− 1.4	12	5,104	se.	30	sw.	12	8	11	11	5.9	......	....
Dubuque	698	81	96	29.24	29.98	+ .05	64.7	− 4.9	86	27	74	44	9	55	30	58	54	70	3.06	− 1.5	10	4,421	nw.	22	n.	12	5	14	11	6.2	......	....
Keokuk	614	64	78	29.30	29.96	+ .02	69.0	− 3.5	89	12	78	44	9	60	30	63	60	77	9.99	+ 5.6	14	4,671	ne.	30	se.	18	9	18	3	4.6	......	....
Cairo	356	87	93	29.57	29.94	− .03	74.4	− 0.8	91	20	83	56	8	66	24	68	65	74	2.42	− 1.9	9	4,617	se.	35	sw.	5	8	12	10	5.8	......	....
Peoria	609	11	45	29.31	29.98	+ .03	67.8	− 3.1	89	29	79	42	8	56	31	62	59	76	2.08	− 2.2	11	3,972	e.	24	w.	18	7	14	9	5.6	......	....
Springfield, Ill	644	10	91	29.28	29.95	.00	69.6	− 2.7	90	12	80	45	8	60	28	63	59	71	3.22	− 1.1	12	5,434	s.	27	nw.	7	5	15	10	6.2	......	....
Hannibal	534	74	109	29.39	29.96	+ .01	69.4	− 3.9	89	12	78	46	8	60	30	......	......	......	8.93	+ 5.4	15	5,632	sw.	50	se.	18	9	9	12	5.7	......	....
St. Louis	567	265	303	29.35	29.95	.00	72.0	− 3.1	90	12	81	54	8	63	27	67	64	78	9.77	− 5.3	13	7,892	s.	49	nw.	13	11	16	3	4.8	......	....
Missouri Valley.							**66.7**	**− 4.2**										**74**	**5.92**	**+ 1.6**										**5.6**		
Columbia, Mo	781	11	84	29.12	29.94	− .01	69.6	− 4.9	89	5	79	46	8	61	29	......	......	......	9.11	+ 4.7	18	4,526	se.	31	nw.	29	3	12	15	7.3	......	....
Kansas City	963	161	181	28.93	29.95	+ .03	70.0	− 3.0	87	12	78	52	9	62	26	63	60	75	7.88	+ 3.2	16	7,525	n.	50	nw.	30	4	19	7	5.9	......	....
St. Joseph	967	11	49	28.93	29.94	......	69.8	......	89	12	80	48	9	60	28	62	59	75	5.77	......	13	5,138	se.	47	nw.	29	7	18	5	5.5	......	....
Springfield, Mo	1,324	98	104	28.58	29.96	+ .01	70.3	− 2.0	90	20	78	50	8	62	23	65	62	77	5.81	+ 0.6	16	6,232	se.	40	nw.	13	13	14	3	4.0	......	....
Iola	984	11	50	28.90	29.92	− .01	71.1	− 2.3	88	10	81	48	8	61	28	......	......	......	8.56	+ 3.8	16	4,419	se.	36	n.	10	3	21	6	5.5	......	....
Topeka	983	85	101	......	......	......	69.8	− 3.7	88	10	79	50	1	61	27	......	......	......	9.10	+ 4.3	15	6,232	se.	42	w.	10	6	16	8	6.1	......	....
Lincoln	1,189	11	84	28.68	29.92	+ .02	67.2	− 4.4	86	25	77	44	9	58	27	61	57	75	4.03	− 0.3	13	6,562	se.	40	nw.	30	6	15	9	5.8	......	....
Omaha	1,105	115	121	28.78	29.94	+ .03	67.6	− 4.0	86	26	76	47	9	59	27	61	58	73	2.83	− 2.2	14	5,457	se.	30	nw.	13	5	19	6	5.4	......	....
Valentine	2,598	47	54	27.24	29.93	+ .07	62.0	− 5.1	86	26	73	34	7	51	38	56	51	69	4.52	+ 0.7	18	7,511	s.	54	sw.	27	8	14	8	5.8	......	....
Sioux City	1,135	94	164	28.74	29.94	+ .04	65.0	− 4.4	84	26	74	40	9	56	28	60	57	77	5.65	+ 1.8	11	8,476	se.	50	s.	15	10	14	6	5.0	......	....
Huron	1,306	59	74	28.57	29.96	+ .08	61.4	− 5.2	83	27	72	36	9	51	30	56	53	75	4.50	+ 0.7	15	7,838	se.	48	se.	9	7	20	3	4.8	......	....
Pierre	1,572	70	75	28.29	29.94	+ .07	63.1	− 5.8	86	27	73	39	7	53	33	56	50	66	4.12	+ 1.0	14	7,254	se.	57	n.	27	9	14	7	5.3	......	....
Yankton	1,233	49	57	28.63	29.93	+ .04	63.8	− 5.6	86	26	74	42	7	54	27	......	......	......	4.99	+ 0.7	15	5,618	se.	36	w.	12	5	14	11	6.3	......	....

TABLE I.—*Climatological data for United States Weather Bureau stations, June, 1915*—Continued.

Districts and stations.	Elevation of instruments: Barometer above sea level.	Elevation of instruments: Thermometer above ground.	Elevation of instruments: Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Pressure: Sea level, reduced to mean of 24 hours.	Pressure: Departure from normal.	Temperature of the air: Mean max. + mean min. ÷ 2.	Temperature of the air: Departure from normal.	Temperature of the air: Maximum.	Temperature of the air: Date.	Temperature of the air: Mean maximum.	Temperature of the air: Minimum.	Temperature of the air: Date.	Temperature of the air: Mean minimum.	Temperature of the air: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity, per cent.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with 0.01 or more.	Wind: Total movement.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F	°F	°F		°F	°F		°F	°F	°F	°F		In.	In.		Miles								0-10		
Northern Slope.							56.8	- 5.3										66	3.66	+ 1.4										5.6		
Havre	2,505	11	44	27.31	29.92	+0.07	56.8	- 5.6	88	24	67	34	16	46	41	51	47	73	3.35	+ 0.5	16	5,375	nw.	31	sw.	25	9	11	10	5.7	......	....
Helena	4,110	87	114	25.80	29.96	+ .08	55.2	- 5.4	83	24	66	37	13	44	39	46	39	61	5.25	+ 3.1	14	6,767	sw.	54	sw.	25	5	15	10	6.2	T.	....
Kalispell	2,962	11	34	26.92	29.95	+ .06	55.8	- 3.0	84	24	67	39	6	44	36	48	42	68	2.09	+ 0.4	15	2,988	w.	20	nw.	9	7	14	9	5.6	......	....
Miles City	2,371	26	48	27.44	29.97	+ .12	61.6	- 4.4	95	25	73	38	8	50	34	53	47	66	5.84	+ 3.1	17	4,206	s.	24	nw.	15	12	9	9	4.9	......	....
Rapid City	3,259	50	58	26.58	29.95	+ .10	59.1	- 4.7	84	27	69	35	7	49	36	52	46	65	5.95	+ 2.4	18	6,523	n.	40	nw.	12	5	16	9	5.9	......	....
Cheyenne	6,088	84	101	24.02	29.90	+ .06	54.6	- 6.9	78	25	66	29	7	43	36	48	42	66	1.34	- 0.2	10	8,688	s.	52	w.	12	3	18	9	6.6	T.	....
Lander	5,372	60	68	24.64	29.93	+ .08	55.4	- 5.9	86	25	70	34	12	41	38	45	35	54	3.75	+ 2.6	10	4,138	w.	36	n.	15	8	17	5	4.8	T.	....
Sheridan	3,790	10	47	26.09	29.96	......	55.6	......	83	25	68	31	7	43	38	50	44	69	4.71	......	18	4,458	nw.	40	se.	25	10	10	10	5.2	T.	....
Yellowstone Park	6,200	11	48	23.89	29.95	+ .09	49.2	- 6.8	78	24	62	30	13	37	41	41	35	66	2.00	+ 0.4	13	5,288	nw.	40	s.	25	7	13	10	5.9	T.	....
North Platte	2,821	11	51	27.07	29.96	+ .10	63.8	- 4.6	84	15	74	38	7	54	34	57	54	75	3.39	+ 0.1	13	5,290	se.	29	nw.	12	10	13	7	4.8	......	....
Middle Slope.							68.2	- 3.6										69	4.73	+ 1.6										5.4		
Denver	5,291	129	172	24.72	29.89	+ .05	62.2	- 4.2	89	11	75	36	7	49	37	51	43	56	1.70	+ 0.2	10	5,858	sw.	41	nw.	17	8	15	7	5.2	......	....
Pueblo	4,685	80	86	25.26	29.87	+ .04	66.0	- 3.0	95	23	79	34	7	53	45	52	42	50	1.26	- 0.2	7	5,111	se.	42	nw.	17	18	6	6	4.0	......	....
Concordia	1,392	50	58	28.48	29.93	+ .03	68.3	- 4.4	86	28	78	48	1	59	27	62	59	76	9.33	+ 4.4	16	5,088	se.	33	se.	19	2	18	10	6.7	......	....
Dodge	2,509	11	51	27.33	29.88	+ .01	68.8	- 4.3	94	17	80	41	7	58	29	62	59	75	2.96	- 0.4	16	7,918	se.	38	s.	1	10	13	7	5.3	......	....
Wichita	1,358	139	158	28.48	29.89	- .02	70.7	- 3.6	92	19	80	49	7	62	25	65	62	76	5.90	+ 1.2	16	8,854	s.	62	w.	17	4	19	7	5.9	......	....
Oklahoma	1,214	10	47	28.65	29.90	- .01	73.7	- 2.0	90	18	82	52	8	65	27	68	66	80	7.23	+ 4.2	15	9,527	s.	74	n.	24	8	18	4	5.2	......	....
Southern Slope.							78.0	+ 0.8										56	1.16	- 1.5										2.9		
Abilene	1,738	10	52	28.10	29.85	- .03	80.7	+ 2.5	102	19	92	50	1	69	33	69	64	62	2.85	- 0.3	7	9,012	s.	54	sw.	25	17	11	2	3.1	......	....
Amarillo	3,676	10	49	26.22	29.86	+ .01	72.4	+ 0.4	103	20	86	42	7	59	37	61	54	62	1.04	- 2.0	7	8,841	s.	37	n.	6	19	8	3	3.1	......	....
Del Rio	944	64	71	28.89	29.85	.00	84.0	+ 1.9	101	18	94	61	1	74	27	....	.....	....	0.63	- 1.8	4	6,194	se.	44	se.	3	19	9	2	2.8	......	....
Roswell	3,566	75	85	26.29	29.81	+ .01	74.9	- 1.4	102	20	91	46	8	59	40	58	45	43	0.14	- 1.9	4	5,949	se.	34	s.	28	20	8	2	2.5	......	....
Southern Plateau.							73.7	- 0.9										31	0.18	- 0.2										1.7		
El Paso	3,762	110	133	26.10	29.74	- .01	81.6	+ 2.0	102	20	95	56	8	68	34	57	35	25	T.	- 0.6	0	8,273	w.	46	ne.	7	21	9	0	1.8	......	....
Santa Fe	7,013	57	62	23.28	29.78	- .03	64.0	- 2.2	86	21	77	38	7	51	31	47	32	34	0.16	- 0.9	4	5,740	sw.	34	sw.	3	18	12	0	3.3	......	....
Flagstaff	6,908	8	57	23.37	29.81	+ .03	56.8	- 2.5	83	30	74	30	5	40	45	....	.....	....	0.42	- 0.1	2	......	w.	38	w.	16	22	7	1	....	T.	....
Phoenix	1,108	76	81	28.63	29.75	+ .01	83.4	- 1.0	106	17	99	58	5	68	40	59	39	26	0.48	+ 0.4	2	3,903	e.	24	w.	3	25	3	2	1.4	......	....
Yuma	141	9	58	29.60	29.74	.00	85.4	+ 0.7	112	30	104	59	14	66	46	65	52	40	0.00	0.0	0	3,609	sw.	19	n.	3	30	0	0	0.3	......	....
Independence	3,910	11	42	25.90	29.80	+ .02	71.0	- 2.4	94	29	87	47	12	55	40	....	.....	....	0.00	- 0.1	0	5,351	se.	36	nw.	16	25	5	0	1.5	......	....
Middle Plateau.							63.2	- 2.5										36	0.54	+ 0.1										2.6		
Reno	4,532	74	81	25.48	29.92	+ .06	61.6	+ 0.6	93	30	78	38	12	46	40	46	32	41	0.00	- 0.2	0	5,800	w.	37	w.	10	29	1	0	0.8	......	....
Tonopah	6,090	12	20	24.07	29.88	......	63.5	......	87	30	75	37	3	52	28	45	27	30	T.	- 0.4	0	6,733	w.	42	nw.	11	24	4	2	1.8	......	....
Winnemucca	4,344	18	56	25.61	29.96	+ .08	61.0	- 2.3	91	30	78	34	13	44	45	45	31	41	0.05	- 0.6	2	4,408	ne.	29	sw.	10	21	6	3	2.2	......	....
Modena	5,479	10	43	24.59	29.85	+ .03	60.8	- 2.4	90	30	78	32	12	44	43	44	24	32	0.85	+ 0.4	3	7,906	sw.	42	w.	1	20	5	5	2.6	T.	....
Salt Lake City	4,360	147	189	25.58	29.88	+ .03	64.2	- 4.1	92	24	76	42	3	53	30	49	36	39	1.44	+ 0.7	7	5,750	nw.	44	nw.	1	20	6	4	2.9	......	....
Grand Junction	4,602	82	96	25.32	29.84	+ .01	68.4	- 4.2	93	24	82	44	4	54	36	49	30	33	0.92	+ 0.5	6	5,586	e.	45	w.	11	19	7	4	3.0	......	....
Northern Plateau.							61.6	- 3.4										48	0.71	- 0.4										4.0		
Baker	3,471	48	53	26.49	30.06	+ .11	56.2	- 2.4	88	23	69	35	11	43	38	45	36	53	0.45	- 0.8	6	4,877	nw.	23	se.	14	13	16	1	3.9	......	....
Boise	2,739	78	86	27.15	29.99	+ .08	61.8	- 4.2	91	23	75	42	10	49	36	49	36	46	0.48	- 0.4	4	4,462	nw.	24	w.	11	17	7	6	3.7	......	....
Lewiston	757	40	48	29.19	30.00	+ .06	65.4	- 3.7	97	23	79	45	10	52	40	....	.....	....	1.44	+ 0.4	5	3,085	e.	19	nw.	16	13	11	6	4.1	......	....
Pocatello	4,477	46	54	25.45	29.91	+ .04	58.4	- 5.8	88	24	72	34	13	45	40	46	34	45	0.57	- 0.4	7	5,410	se.	34	sw.	10	12	16	2	4.1	......	....
Spokane	1,929	101	110	27.96	29.99	+ .05	61.4	- 2.0	89	23	73	44	11	50	36	50	40	51	0.92	- 0.7	6	4,901	sw.	27	sw.	12	13	14	3	4.3	......	....
Walla Walla	1,000	57	65	28.94	30.00	+ .04	66.1	- 2.1	92	30	78	48	11	54	33	53	41	45	0.40	- 0.8	4	3,992	s.	21	w.	16	16	9	5	3.8	......	....
North Pacific Coast Region.							58.2	+ 0.6										76	0.67	- 1.4										4.9		
North Head	211	11	56	29.96	30.19	+ .20	55.4	+ 0.4	70	30	58	48	10	53	13	53	51	86	0.85	- 0.9	10	11,522	nw.	44	se.	24	4	20	6	5.5	......	....
Port Crescent	259	8	53	29.89	30.18	+ .15	52.8	- 0.6	80	30	61	38	21	45	32	....	.....	....	0.27	- 1.6	5	3,608	w.	16	w.	6	8	18	4	4.8	......	....
Seattle	125	215	250	30.02	30.14	+ .14	59.8	- 0.3	86	30	67	47	10	52	27	54	50	74	0.40	- 1.3	8	5,601	s.	27	ne.	6	9	10	11	5.7	......	....
Tacoma	213	113	120	29.92	30.14	+ .11	59.6	+ 0.2	84	30	68	45	3	51	28	53	49	72	0.66	- 1.5	6	4,293	sw.	23	sw.	16	9	12	9	5.4	......	....
Tatoosh Island	109	7	57	30.05	30.15	+ .12	55.0	+ 2.0	76	30	59	46	10	51	25	52	51	90	0.28	- 3.9	5	6,829	sw.	30	s.	24	11	8	11	5.2	......	....
Portland, Oreg	153	68	106	29.97	30.13	+ .09	62.6	+ 1.3	95	30	72	47	3	53	32	55	50	68	1.47	- 0.3	9	4,052	nw.	21	w.	24	15	9	6	4.2	......	....
Roseburg	510	9	57	29.58	30.13	+ .10	62.0	+ 1.1	98	30	75	43	10	49	43	53	47	64	0.71	- 0.4	6	2,743	n.	18	n.	3	11	16	3	3.6	......	....
Middle Pacific Coast Region.							62.3	- 0.3										58	0.01	- 0.4										1.7		
Eureka	62	73	89	30.07	30.14	+ .09	54.0	- 0.6	63	23	58	46	4	50	13	51	49	84	0.05	- 1.0	3	6,308	n.	38	n.	2	17	9	4	4.0	......	....
Mt. Tamalpais	2,375	11	18	27.55	30.00	+ .05	63.6	- 0.5	84	7	71	44	11	56	21	50	37	39	0.00	- 0.4	0	15,300	nw.	88	nw.	10	30	0	0	0.2	......	....
Point Reyes Light	490	7	18	29.45	29.97	......	51.6	- 1.2	64	4	55	44	26	48	17	....	.....	....	0.00	......	0	22,818	nw.	81	nw.	10	15	7	8	4.0	......	....
Red Bluff	332	50	56	29.58	29.92	+ .04	75.0	- 0.7	101	28	89	49	11	61	35	57	42	36	0.00	- 0.5	0	4,808	nw.	30	n.	3	30	0	0	0.3	......	....
Sacramento	69	106	117	29.86	29.92	+ .03	69.8	+ 0.9	96	29	84	50	25	56	35	57	47	55	0.00	- 0.2	0	7,022	s.	40	nw.	3	30	0	0	0.1	......	....
San Francisco	155	209	213	29.83	30.00	+ .04	58.9	+ 1.9	83	3	66	48	14	52	24	52	48	76	0.00	- 0.2	0	8,776	sw.	35	sw.	9	25	5	0	1.6	......	....
San Jose	141	12	110	29.85	30.00	......	63.4	- 1.6	89	28	77	43	20	50	36	....	.....	....	0.00	- 0.1	0	4,540	nw.	24	nw.	3	27	3	0	1.8	......	....
South Pacific Coast Region.							66.8	+ 0.6										66	T.	- 0.1										2.5		
Fresno	327	89	98	29.55	29.90	+ .05	75.0	- 0.8	102	8	91	51	25	59	37	56	39	36	0.00	- 0.1	0	7,378	nw.	31	nw.	11	28	2	0	0.7	......	....
Los Angeles	338	159	191	29.56	29.92	+ .02	66.7	+ 2.2	85	17	76	55	16	57	29	59	55	74	T.	- 0.1	0	3,596	sw.	16	sw.	11	19	8	3	3.5	......	....
San Diego	87	62	70	29.83	29.92	.00	64.8	+ 1.0	77	17	70	57	12	60	16	60	58	82	T.	0.0	0	4,772	nw.	21	nw.	30	21	6	3	3.7	......	....
San Luis Obispo	201	32	40	29.78	30.00	+ .05	60.6	+ 0.2	84	14	74	43	19	48	38	52	48	72	0.01	- 0.1	1	3,340	nw.	20	w.	24	26	4	0	2.0	......	....
West Indies.																																
San Juan	82	8	54	29.89	29.97	- .02	80.6	......	92	23	86	73	14	76	18	....	.....	....	6.07	+ 0.2	16	9,474	e.	37	e.	14	15	11	4	4.1	......	....
Panama.																																
Balboa Heights	116	7	97	29.70	29.82	......	81.0	......	92	19	87	74	11	76	18	77	76	90	2.85	- 5.0	18	4,617	nw.	25	s.	5	0	8	22	8.3	......	....
Colon	25	5	71	29.79	29.82	......	81.2	......	89	16	86	75	8	77	12	78	77	89	16.01	+ 2.6	25	5,205	se.	27	s.	6	0	9	21	7.9	......	....

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during June, 1915, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive rate began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	24-25	8:05 p.m.	D.N.a.m.	1.45	8:24 p.m.	9:04 p.m.	0.09	0.12	0.31	0.50	0.72	0.90	1.00	1.12	1.23						
Albany, N. Y	18	2:34 p.m.	3:03 p.m.	0.38	2:34 p.m.	2:49 p.m.	.00	.22	.24	.37											
Alpena, Mich	6	5:40 p.m.	7:40 p.m.	2.21	5:45 p.m.	6:10 p.m.	.01	.42	.71	.90	1.29	1.57									
Amarillo, Tex	25			0.40														0.34			
Anniston, Ala	27			0.61														.25			
Asheville, N. C	30	3:15 p.m.	4:50 p.m.	0.54	4:27 p.m.	4:39 p.m.	.15	.16	.33	.38											
Atlanta, Ga	12	5:50 p.m.	8:40 p.m.	1.79	5:56 p.m.	6:33 p.m.	.01	.17	.55	.89	1.18	1.39	1.52	1.58							
Atlantic City, N. J	22	5:10 p.m.	6:37 p.m.	0.57	5:20 p.m.	5:30 p.m.	.01	.34	.43												
Augusta, Ga	15	10:15 p.m.	10:45 p.m.	1.13	10:18 p.m.	10:34 p.m.	.01	.23	.67	1.09	1.12										
Baker, Oreg	13			0.23														.17			
Baltimore, Md	13	2:50 p.m.	4:30 p.m.	1.43	2:55 p.m.	3:33 p.m.	.01	.28	.59	.94	1.06	1.11	1.25	1.33	1.38						
Bentonville, Ark	11	5:18 a.m.	11:00 a.m.	1.68	9:12 a.m.	9:40 a.m.	.69	.15	.36	.51	.65	.79	.85								
	23-24	10:22 p.m.	7:35 a.m.	2.49	3:05 a.m.	3:40 a.m.	.81	.12	.26	.35	.42	.54	.62	.70							
					4:16 a.m.	5:01 a.m.	1.61	.05	.14	.18	.21	.26	.37	.44	.56	0.78					
Binghamton, N. Y	19	7:20 p.m.	7:55 p.m.	0.83	7:32 p.m.	7:50 p.m.	.04	.05	.23	.57	.79										
Birmingham, Ala	6	3:38 p.m.	4:13 p.m.	0.70	3:43 p.m.	3:59 p.m.	.02	.13	.48	.64	.67										
	16	1:02 p.m.	2:36 p.m.	0.78	1:28 p.m.	1:58 p.m.	.01	.17	.31	.48	.67	.71	.77								
	28	8:46 p.m.	D.N.p.m.	1.41	8:46 p.m.	9:17 p.m.	.00	.25	.81	.99	1.08	1.16	1.22	1.25							
Bismarck, N. Dak	15	3:34 p.m.	4:15 p.m.	0.49	3:56 p.m.	4:06 p.m.	.02	.22	.42												
Block Island, R. I	17	10:30 a.m.	11:00 a.m.	0.67	10:32 a.m.	10:54 a.m.	T.	.22	.34	.50	.63	.67									
Boise, Idaho	18			0.31														.28			
Boston, Mass	17			0.69														.41			
Buffalo, N. Y	19			0.44														.39			
Burlington, Vt	11			1.13														*			
Cairo, Ill	4	5:38 p.m.	7:30 p.m.	0.68	6:11 p.m.	6:26 p.m.	.06	.22	.38	.55											
Canton, N. Y	13-14	11:25 p.m.	D.N.a.m.	0.70	11:32 p.m.	11:47 p.m.	.02	.11	.42	.50											
Charles City, Iowa	23-24			1.10														*			
Charleston, S. C	1-2	7:30 p.m.	D.N.a.m.	1.24	8:41 p.m.	9:29 p.m.	.02	.10	.13	.29	.38	.49	.62	.75	.83	.89	0.94				
Charlotte, N. C	14	8:38 p.m.	D.N.p.m.	0.97	8:52 p.m.	9:31 p.m.	.05	.20	.35	.39	.46	.57	.66	.72	.80						
Chattanooga, Tenn	11	1:18 p.m.	2:21 p.m.	0.63	1:28 p.m.	1:43 p.m.	.01	.23	.47	.58											
Cheyenne, Wyo	5-6			0.34														.16			
Chicago, Ill	12-13	10:45 p.m.	D.N.a.m.	1.54	11:02 p.m.	11:47 p.m.	.01	.18	.31	.46	.56	.72	.82	.89	.92	.98					
Cincinnati, Ohio	1	12:07 p.m.	D.N.p.m.	0.90	1:15 p.m.	1:29 p.m.	.14	.17	.39	.47											
Cleveland, Ohio	2			0.68														*			
Columbia, Mo	10	3:34 a.m.	12:10 p.m.	0.83	10:36 a.m.	10:51 a.m.	.01	.35	.70	.76											
	16	2:57 p.m.	6:20 p.m.	1.08	3:37 p.m.	4:12 p.m.	.03	.07	.12	.27	.36	.43	.57	.79							
	27	5:30 p.m.	7:10 p.m.	1.02	6:21 p.m.	6:55 p.m.	.01	.06	.41	.63	.76	.85	.91	.96							
	29	8:50 p.m.	D.N.p.m.	0.90	9:11 p.m.	9:38 p.m.	.05	.16	.37	.55	.68	.75	.79								
Columbia, S. C	18	1:45 p.m.	3:15 p.m.	0.80	1:51 p.m.	2:10 p.m.	.01	.24	.50	.65	.74										
Columbus, Ohio	7	3:13 p.m.	4:25 p.m.	1.02	3:23 p.m.	3:43 p.m.	.39	.68	.94	1.00											
	13	3:40 p.m.	6:30 p.m.	0.91	3:48 p.m.	4:10 p.m.	.11	.40	.53	.74	.81										
Concord, N. H	17			0.38														.27			
Concordia, Kans	17	8:07 a.m.	11:03 a.m.	4.02	9:26 a.m.	10:33 a.m.	.34	†	†	†	†	†	†	†	3.28	3.28	3.28	3.52	3.63		
	19	5:19 a.m.	7:09 a.m.	2.05	5:21 a.m.	6:37 a.m.	.01	.42	.69	.85	1.05	1.17	1.37	1.50	1.59	1.66	1.70	1.74	2.03		
	30	3:38 p.m.	4:13 p.m.	0.86	3:40 p.m.	4:06 p.m.	.01	.13	.28	.62	.76	.83	.85								
Corpus Christi, Tex	4			T.														T.			
Davenport, Iowa	12	9:28 p.m.	12:20 p.m.	0.51	9:31 p.m.	9:55 p.m.	.01	.09	.22	.31	.44	.49									
Dayton, Ohio	26	4:27 p.m.	5:50 p.m.	0.80	4:42 p.m.	4:59 p.m.	.04	.09	.35	.69	.72										
Del Rio, Tex	5			0.53														.39			
Denver, Colo	23-24			0.36														.22			
Des Moines, Iowa	4	3:50 a.m.	6:10 a.m.	0.56	5:47 a.m.	6:00 a.m.	.12	.30	.38	.43											
Detroit, Mich	16-17			0.89														.46			
Devils Lake, N. Dak	20	5:29 p.m.	6:40 p.m.	0.55	6:00 p.m.	6:15 p.m.	.06	.19	.35	.41											
Dodge City, Kans	4	8:57 a.m.	9:15 a.m.	0.47	8:59 a.m.	9:07 a.m.	T.	.28	.47												
Dubuque, Iowa	12	6:40 p.m.	9:20 p.m.	1.05	7:36 p.m.	8:17 p.m.	.02	.07	.16	.26	.48	.69	.84	.90	.97	.99					
Duluth, Minn	28	3:37 p.m.	4:33 p.m.	0.48	3:42 p.m.	3:47 p.m.	.01	.39													
Durango, Colo																					
Eastport, Me	17			0.71														.52			
Elkins, W. Va	21	8:03 p.m.	9:50 p.m.	0.42	9:20 p.m.	9:36 p.m.	.04	.10	.18	.36	.38										
El Paso, Tex	23			T.														T.			
Erie, Pa	21			0.68														.42			
Escanaba, Mich	6			0.65														.39			
Eureka, Cal	15			0.03														.02			
Evansville, Ind	6	8:01 p.m.	9:00 p.m.	0.56	8:11 p.m.	8:27 p.m.	.01	.33	.43	.50	.53										
	21	12:05 a.m.	6:30 a.m.	1.50	12:46 a.m.	1:10 a.m.	.01	.37	.69	.86	.94	1.00									
Flagstaff, Ariz	4			0.31														*			
Fort Smith, Ark	22	11:48 a.m.	1:04 p.m.	0.62	11:52 a.m.	12:11 p.m.	.06	.16	.39	.52	.56										
	27	8:43 a.m.	1:50 p.m.	1.44	9:01 a.m.	9:44 a.m.	.02	.07	.13	.35	.62	.73	.79	.82	.87	.93					
Fort Wayne, Ind	25	4:46 p.m.	5:55 p.m.	0.54	5:00 p.m.	5:17 p.m.	.04	.15	.31	.39	.43										
Fort Worth, Tex	5	6:51 p.m.	9:15 p.m.	0.91	7:58 p.m.	8:36 p.m.	.07	.18	.25	.33	.43	.47	.59	.73	.77						
	5-6	11:08 p.m.	3:15 p.m.	1.21	12:45 a.m.	1:19 a.m.	.21	.12	.21	.30	.53	.76	.86	.91							
	14	1:49 p.m.	3:09 p.m.	0.70	2:07 p.m.	2:38 p.m.	.01	.07	.22	.37	.48	.56	.64	.68							
	15	12:38 a.m.	4:10 a.m.	0.74	1:24 a.m.	1:42 a.m.	.12	.12	.42	.56	.62										
	25	12:19 p.m.	3:19 p.m.	2.82	12:57 p.m.	2:30 p.m.	.04	.11	.21	.33	.35	.37	.50	.59	.86	1.16	1.32	1.83	2.57	2.77	
Fresno, Cal	‡																				
Galveston, Tex	15			0.08														.08			
Grand Haven, Mich	18	1:48 p.m.	3:10 p.m.	0.62	2:17 p.m.	2:32 p.m.	.07	.06	.30	.50											
Grand Junction, Colo	4-6			0.67														*			
Grand Rapids, Mich	12-13			0.68														.25			
Green Bay, Wis	18			0.72														.20			
Hannibal, Mo	7	D.N.a.m.	D.N.a.m.	0.81	1:31 a.m.	1:45 a.m.	.04	.40	.63	.71											
	10-11	8:01 p.m.	D.N.a.m.	1.97	8:10 p.m.	8:58 p.m.	.04	.13	.35	.48	.54	.69	.77	1.01	1.30	1.40	1.46				
	20	6:26 p.m.	9:20 p.m.	1.45	7:53 p.m.	8:35 p.m.	.08	.13	.29	.55	.74	.91	.99	1.07	1.17	1.23					
Harrisburg, Pa	2-3			1.47														*			
Hartford, Conn	15			0.41														.27			
Hatteras, N. C	1-2	7:31 p.m.	10:30 a.m.	3.04	6:48 a.m.	7:56 a.m.	1.67	.05	.12	.19	.28	.37	.43	.49	.57	.63	.70	.81	1.01		
Havre, Mont	2-3			0.85														*			
Helena, Mont	10-12			2.49														.22			
Houghton, Mich	5-6			1.98														*			
Houston, Tex	15			0.33														.33			
Huron, S. Dak	5	D.N.a.m.	7:05 a.m.	0.94	5:26 a.m.	6:03 a.m.	.08	.23	.35	.48	.57	.62	.67	.73	.78						
	23	6:22 p.m.	7:10 p.m.	0.60	6:27 p.m.	6:49 p.m.	.01	.16	.40	.43	.55	.59									
Independence, Cal	‡																				
Indianapolis, Ind	15	12:28 p.m.	2:12 p.m.	0.58	12:38 p.m.	12:48 p.m.	.02	.22	.44												
Iola, Kans	10-11	10:55 p.m.	9:15 a.m.	2.34	5:32 a.m.	6:02 a.m.	.53	.15	.38	.98	1.20	1.28	1.37								
	30	5:02 p.m.	7:35 p.m.	1.40	5:42 p.m.	6:03 p.m.	.11	.20	.46	.58	.70										
Jacksonville, Fla	25			0.87														.53			
Kalispell, Mont	25-27			1.08														.30			
Kansas City, Mo	10-11	6:50 p.m.	D.N.a.m.	1.43	7:19 p.m.	7:45 p.m.	.03	.23	.39	.55	.81	1.06	1.11								
	29	4:13 p.m.	8:00 p.m.	1.22	6:30 p.m.	6:50 p.m.	.26	.21	.33	.62	.79										

* Self-register not working. † Record imperfect. ‡ No precipitation during the month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during June, 1915, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Keokuk, Iowa	10	3:30 p. m.	8:45 p. m.	3.77	4:10 p. m.	5:10 p. m.	0.07	0.08	0.33	0.51	†	†	†	†	1.55	1.62	1.75	2.09			
					7:02 p. m.	7:40 p. m.	2.51	.09	.23	.36	0.58	0.66	0.78	1.01	1.10						
	19	3:10 p. m.	6:05 p. m.	0.83	3:54 p. m.	4:32 p. m.	.03	.09	.16	.19	.29	.35	.52	.63	.68						
Key West, Fla	20	8:45 a. m.	11:40 a. m.	0.77	9:40 a. m.	10:00 a. m.	.01	.16	.35	.53	.68										
Knoxville, Tenn	30	D. N. a. m.	6:00 a. m.	1.39	2:13 a. m.	3:57 a. m.	.01	.13	.21	.26	.29	.37	.46	.52	.54	.55	.57	.62	.78	1.24	1.37
La Crosse, Wis	28	4:25 p. m.	8:00 p. m.	1.12	4:47 p. m.	5:08 p. m.	.03	.12	.46	.59	.65	.68									
Lander, Wyo	1–2			2.11														.25			
Lansing, Mich	18	1:38 p. m.	3:10 p. m.	1.16	2:18 p. m.	2:42 p. m.	.02	.18	.31	.63	1.01	1.10									
Lewiston, Idaho	11			0.83														.35			
Lexington, Ky	7			0.42														.36			
Lincoln, Nebr	30	1:53 p. m.	5:10 p. m.	0.66	2:34 p. m.	2:51 p. m.	.04	.23	.36	.42	.47										
Little Rock, Ark	14	11:31 a. m.	12:45 p. m.	1.15	11:31 a. m.	12:04 p. m.	.00	.15	.28	.67	.81	.88	.99	1.01							
Los Angeles, Cal	30			T.														T.			
Louisville, Ky	1	1:24 p. m.	6:10 p. m.	0.61	1:24 p. m.	1:41 p. m.	.00	.06	.21	.40	.48										
Ludington, Mich	18			0.95														.51			
Lynchburg, Va	1–3			3.20														.41			
Macon, Ga	1–2			0.88														.51			
Madison, Wis	12			0.47														.43			
Marquette, Mich	28	2:11 p. m.	7:31 p. m.	1.38	3:57 p. m.	4:38 p. m.	.28	.06	.09	.18	.41	.63	.78	.88	.96	.98					
Memphis, Tenn	30	7:38 p. m.	D.N. p. m.	0.81	8:48 p. m.	9:10 p. m.	.16	.15	.32	.43	.53	.59									
Meridian, Miss	13–14	10:40 p. m.	D. N. a. m.	1.04	11:32 p. m.	12:18 a. m.	.06	.06	.21	.22	.38	.29	.31	.57	.86	.96					
	26	1:15 p. m.	4:30 p. m.	0.98	1:18 p. m.	1:43 p. m.	.01	.12	.16	.49	.66	.74									
	27	1:20 p. m.	3:20 p. m.	1.23	1:32 p. m.	1:59 p. m.	.01	.12	.16	.30	.70	1.06	1.16								
	28	7:35 p. m.	9:00 p. m.	0.56	7:44 p. m.	7:59 p. m.	.01	.31	.45	.51											
Miami, Fla	1	2:25 p. m.	5:35 p. m.	1.64	3:36 p. m.	4:53 p. m.	.21	.13	.23	.25	.37	.51	.53	.55	.69	.79	.88	1.08	1.36		
	2	D. N. a. m.	1:15 p. m.	2.25	6:01 a. m.	6:55 a. m.	.12	.07	.19	.29	.37	.38	.42	.52	.65	.78	.83	.90			
	14	D. N. a. m.	D. N. a. m.	1.01	4:28 a. m.	4:44 a. m.	.14	.18	.50	.71	.73										
	17	D. N. a. m.	8:05 a. m.	2.77	5:16 a. m.	5:55 a. m.	1.53	.15	.32	.48	.66	.84	.92	.97	1.02						
Milwaukee, Wis	12–13	8:20 p. m.	D. N. a. m.	0.80	8:52 p. m.	9:22 p. m.	.01	.15	.23	.31	.43	.47	.54								
Minneapolis, Minn	5	7:30 p. m.	D.N. p. m.	0.95	9:46 p. m.	9:55 p. m.	.24	.36	.64												
	27	D. N. a. m.	D. N. a. m.	1.03	1:58 a. m.	2:36 a. m.	.02	.12	.35	.43	.46	.61	.68	.75	.78						
Mobile, Ala	25	12:35 p. m.	3:35 p. m.	1.54	12:38 p. m.	1:09 p. m.	.01	.10	.53	.85	1.13	1.28	1.37	1.42							
	27	12:20 p. m.	1:50 p. m.	0.53	12:22 p. m.	12:34 p. m.	.01	.24	.45	.50											
	28–29	6:35 p. m.	D. N. a. m.	2.61	8:08 p. m.	9:04 p. m.	.03	.25	.56	1.17	1.58	1.90	2.00	2.06	2.08	2.13	2.20	2.31			
	29	2:32 p. m.	7:20 p. m.	0.79	2:41 p. m.	2:52 p. m.	.01	.27	.45	.50											
Modena, Utah	3–4			0.83														.19			
Montgomery, Ala	12	12:48 p. m.	1:45 p. m.	0.43	1:08 p. m.	1:21 p. m.	.01	.17	.27	.39											
Moorhead, Minn	26	5:40 p. m.	10:05 p. m.	2.62	6:00 p. m.	6:23 p. m.	.07	.25	.71	1.11	1.62	1.90									
					7:56 p. m.	8:09 p. m.	2.06	.17	.37	.45											
Mount Tamalpais, Cal	‡																				
Nantucket, Mass	17	1:59 p. m.	3:55 p. m.	0.64	2:06 p. m.	2:31 p. m.	.01	.14	.25	.40	.43	.52	.53								
Nashville, Tenn	27			0.54														.43			
New Haven, Conn	[1] 30–1	10:05 p. m.	8:45 a. m.	2.14	10:34 p. m.	11:17 p. m.	.01	.06	.17	.23	.26	.34	.52	.69	.84	.92					
New Orleans, La	13	9:05 a. m.	10:05 a. m.	1.18	9:09 a. m.	9:39 a. m.	.01	.20	.74	.89	.99	1.08	1.13								
		11:45 a. m.	2:40 p. m.	0.84	12:30 p. m.	12:58 p. m.	.01	.22	.47	.57	.61	.73	.76								
	14	11:10 a. m.	1:55 p. m.	1.31	11:40 a. m.	12:04 p. m.	.04	.16	.32	.67	1.08	1.24									
	14–15	10:15 p. m.	D. N. a. m.	0.85	12:16 a. m.	12:51 a. m.	.01	.19	.28	.33	.41	.51	.61	.70							
	30	3:40 p. m.	5:05 p. m.	0.72	3:15 p. m.	4:09 p. m.	.01	.10	.30	.41	.54	.60									
New York, N. Y	15	5:26 p. m.	10:12 p. m.	1.26	5:26 p. m.	6:06 p. m.	.00	.10	.21	.27	.33	.40	.47	.59	.69						
	[1] 30–1	8:45 p. m.	4:00 a. m.	1.63	10:28 p. m.	11:18 p. m.	.41	.08	.17	.33	.48	.63	.72	.81	.90	.99	1.06				
Norfolk, Va	1–6			5.77														.65			
Northfield, Vt	17	5:50 a. m.	8:20 a. m.	0.89	6:16 a. m.	6:44 a. m.	.01	.05	13	.36	.59	.70	.76								
North Head, Wash	9–10			0.40														.26			
North Platte, Nebr	26	10:05 p. m.	11:10 p. m.	0.49	10:19 p. m.	10:29 p. m.	.02	.35	.43												
Oklahoma, Okla	16	7:18 a. m.	10:00 a. m.	0.75	7:40 a. m.	8:05 a. m.	.03	.21	.29	.35	.43	.50									
	24	2:20 a. m.	6:32 a. m.	1.41	2:37 a. m.	3:17 a. m.	.01	.05	.15	.19	.23	.34	.46	.57	.62						
	25	12:50 p. m.	1:35 p. m.	0.64	1:01 p. m.	1:12 p. m.	.01	.18	.56	.61											
	29	1:21 a. m.	D. N. a. m.	1.13	1:53 a. m.	2:12 a. m.	.03	.11	.44	.70	.76										
Omaha, Nebr	4	2:00 a. m.	6:10 a. m.	0.66	4:26 a. m.	5:00 a. m.	.04	.13	.16	.17	.31	.43	.54	.60							
Oswego, N. Y	19	11:50 a. m.	12:11 p. m.	0.42	11:50 a. m.	12:05 p. m.	.00	.06	.22	.41											
Palestine, Tex	15	1:30 a. m.	7:10 a. m.	1.50	1:41 a. m.	2:31 a. m.	.02	.07	.17	.29	.42	.56	.67	.86	1.03	1.19	1.29				
Parkersburg, W. Va	14	6:53 p. m.	8:51 p. m.	0.78	6:56 p. m.	7:21 p. m.	.01	.15	.30	.46	.54	.59									
Pensacola, Fla	13	4:55 a. m.	8:55 a. m.	1.23	5:33 a. m.	6:27 a. m.	.02	.22	.31	.44	.47	.49	.50	.50	.51	.63	.81	.88			
	25	4:30 a. m.	9:40 a. m.	1.11	4:45 a. m.	5:04 a. m.	.01	.21	.38	.49	.56										
	28	12:50 p. m.	4:10 p. m.	1.27	2:30 p. m.	3:46 p. m.	.03	.13	.31	.43	.54	.61	.55	.66	.66	.68	.76	.98	1.24		
Peoria, Ill	18			0.51														.29			
Philadelphia, Pa	13	4:40 p. m.	6:45 p. m.	0.90	4:50 p. m.	5:10 p. m.	.01	.24	.49	.60	.75										
Phoenix, Ariz	3–4			0.48														.37			
Pierre, S. Dak	12	12:05 a. m.	5:10 a. m.	1.28	3:43 a. m.	4:14 a. m.	.45	.10	.26	.38	46	.54	.60	.64							
Pittsburg, Pa	7	7:35 p. m.	9:10 p. m.	0.47	8:07 p. m.	8:17 p. m.	.02	.24	.39												
Pocatello, Idaho	5			0.23														.12			
Point Reyes Light, Cal	‡																				
Port Huron, Mich	7			0.66														.40			
Portland, Me	20			0.74														.30			
Portland, Oreg	25			0.39														.23			
Providence, R. I	26			0.38														.33			
Pueblo, Colo	1			0.48														.37			
Raleigh, N. C	1–2			1.77														.33			
Rapid City, S. Dak	18–19	2:36 p. m.	2:10 a. m.	1.84	4:12 p. m.	4:46 p. m.	.07	.15	.30	.42	.62	.70	.75	.80							
Reading, Pa	13	2:30 p. m.	5:06 p. m.	0.74	2:45 p. m.	3:08 p. m.	.04	.08	.18	.34	.56	.61									
Red Bluff, Cal	‡																				
Reno, Nev	‡																				
Richmond, Va	1–3			2.42														*			
Rochester, N. Y	15	10:54 a. m.	1:35 p. m.	0.56	11:20 a. m.	11:40 a. m.	.03	.11	.29	.36	.48										
Roseburg, Oreg	10–11			0.58														.24			
Roswell, N. Mex	9			0.06														.06			
Sacramento, Cal	‡																				
Saginaw, Mich	18	5:58 p. m.	6:40 p. m.	0.88	6:00 p. m.	6:12 p. m.	.01	.54	.70	.75											
St. Joseph, Mo	12	2:10 a. m.	D.N. a. m.	0.52	3:16 a. m.	3:32 a. m.	.01	.18	.36	.47	.50										
	17	7:20 p. m.	9:30 p. m.	1.69	8:18 p. m.	8:43 p. m.	.20	.50	.83	1.01	1.21	1.43									
	29	3:04 p. m.	7:28 p. m.	2.06	4:40 p. m.	5:15 p. m.	.21	.11	.25	.51	.77	1.03	1.29	1.46							
St. Louis, Mo	20–21	9:42 p. m.	D. N. a. m.	1.63	10:23 p. m.	11:26 p. m.	.02	.06	.16	.43	.69	.76	.78	.82	.90	1.09	1.26	1.53	1.60		
	27–28	5:40 p. m.	11:45 a. m.	4.27	9:43 p. m.	10:03 p. m.	.90	.30	.51	.76	.88										
St. Paul, Minn	27			0.77														.53			
Salt Lake City, Utah	[2] 31–2			1.29														.64			
San Antonio, Tex	5			0.03														.02			
San Diego, Cal	2			T.														T.			
Sand Key, Fla	19	1:08 p. m.	2:00 p. m.	0.83	1:11 p. m.	1:26 p. m.	.02	.19	.51	.72											
	20	2:13 p. m.	3:07 p. m.	0.78	2:20 p. m.	2:38 p. m.	.04	.18	.42	.60	.65										

*Self-register not working. ‡ No precipitation occurred during month. † Record imperfect. [1] July 1. [2] May 31.

TABLE II.—*Accumulated amount of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during June, 1915, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Sandusky, Ohio	13	3:10 p. m.	5:45 p. m.	1.02	3:13 p. m.	3:33 p. m.	0.01	0.25	0.50	0.70	0.84										
San Francisco, Cal	‡																				
San Jose, Cal	‡																				
San Luis Obispo, Cal	18			0.01														0.01			
Santa Fe, N. Mex	2			0.06														.05			
Sault Ste. Marie, Mich	18–19			1.17														.36			
Savannah, Ga	17			0.99														.59			
Scranton, Pa	15	2:14 p. m.	3:58 p. m.	0.75	2:35 p. m.	2:47 p. m.	.06	.18	.38	.46											
	19	12:28 p. m.	1:52 p. m.	0.68	1:02 p. m.	1:18 p. m.	.25	.10	.21	.40	.41										
Seattle, Wash	10			0.24														.09			
Sheridan, Wyo	11–12			1.98														*			
Shreveport, La	26	4:50 p. m.	7:10 p. m.	0.83	5:45 p. m.	5:59 p. m.	.07	.26	.65	.73											
Sioux City, Iowa	5	3:45 p. m.	4:30 p. m.	0.88	4:06 p. m.	4:23 p. m.	.01	.34	.70	.81	.87										
Southeast Farallone, Cal																					
Spokane, Wash	10–11			0.63														.17			
Springfield, Ill	10–11			0.80														*			
Springfield, Mo	30	7:55 p. m.	11:10 p. m.	0.96	9:15 p. m.	9:37 p. m.	.08	.28	.55	.68	.74	0.80									
Syracuse, N. Y	15	1:26 p. m.	2:25 p. m.	0.42	1:28 p. m.	1:38 p. m.	T.	.25	.36												
Tacoma, Wash	9–10			0.46														.19			
Tampa, Fla	8	1:39 p. m.	3:20 p. m.	0.92	1:47 p. m.	2:27 p. m.	.03	.10	.20	.25	.31	.44	0.57	0.68	0.77						
	11	2:55 p. m.	4:30 p. m.	0.68	3:29 p. m.	3:58 p. m.	.08	.11	.13	.18	.27	.46	.56								
Tatoosh Island, Wash	24			0.13														.09			
Taylor, Tex	15			0.23														.11			
Terre Haute, Ind	29			0.73														.57			
Thomasville, Ga	1	2:15 p. m.	4:40 p. m.	1.53	2:24 p. m.	3:15 p. m.	.01	.32	.45	.52	.59	.73	.87	1.04	1.10	1.17	1.22	1.29			
	28	10:43 a. m.	1:25 p. m.	0.66	11:08 a. m.	11:35 a. m.	.04	.12	.20	.31	.40	.49	.51								
	29	11:15 a. m.	12:47 p. m.	1.10	11:36 a. m.	11:53 a. m.	.05	.19	.31	.63	.72										
Toledo, Ohio	29			0.53														.31			
Tonopah, Nev	4			T.														T.			
Topeka, Kans	10–11	5:56 p. m.	7:35 a. m.	3.82	6:52 p. m.	8:14 p. m.	.21	.22	.43	.56	.64	.96	1.12	1.27	1.39						
					9:24 p. m.	9:39 p. m.	2.67	.07	.28	.65											
	17	5:25 p. m.	7:30 p. m.	1.12	6:22 p. m.	6:53 p. m.	.25	.09	.17	.42	.55	.57	.75	.78							
	19	7:36 a. m.	8:50 a. m.	0.87	7:58 p. m.	8:33 a. m.	.04	.10	.20	.29	.36	.44	.64	.80							
Valentine, Nebr	12	12:15 a. m.	2:00 a. m.	0.50	2:24 a. m.	2:39 a. m.	.10	.08	.23	.38											
Vicksburg, Miss	13	7:34 p. m.	D. N. p. m.	2.61	8:29 p. m.	9:20 p. m.	.00	.17	.42	.66	.92	1.24	1.50	1.71	2.03	2.23	2.33	2.41			
	14	6:20 p. m.	11:00 p. m.	1.07	6:59 p. m.	7:19 p. m.	.15	.17	.34	.45	.57										
Walla Walla, Wash	11			0.29														.16			
Washington, D. C	13	2:33 p. m.	3:50 p. m.	0.70	3:20 p. m.	3:42 p. m.	.03	.17	.35	.47	.60	.65									
	15	3:30 p. m.	4:32 p. m.	1.54	3:37 p. m.	4:27 p. m.	.01	.34	.38	.39	.54	1.00	1.29	1.36	1.39	1.40	1.51				
Wichita, Kans	6–7	5:30 p. m.	D. N. a. m.	1.12	8:12 p. m.	8:47 p. m.	.04	.07	.12	.18	.27	.47	.58	.63							
	23–24	9:30 p. m.	D. N. a. m.	0.89	11:07 p. m.	11:35 p. m.	.08	.10	.21	.33	.47	.60	.65								
Williston, N. Dak	2–3			0.71														.21			
Wilmington, N. C	8–9	10:35 p. m.	D. N. a. m.	1.08	12:09 a. m.	2:34 a. m.	.33	.19	.40	.54	.64	.70									
Winnemucca, Nev	11			0.03														.02			
Wytheville, Va	14	2:18 p. m.	4:40 p. m.	0.78	2:22 p. m.	2:32 p. m.	.01	.16	.32												
Yankton, S. Dak	26–27	11:15 p. m.	2:00 a. m.	0.71	11:19 p. m.	11:45 p. m.	.01	.24	.42	.46	.53	.58	.61								
Yellowstone Park, Wyo	17			0.47														.17			

* Self-register not working. ‡ No precipitation occurred during month.

TABLE III.—*Data furnished by the Canadian Meteorological S-rvice, June, 1915.*

Stations.	Pressure.			Temperature.						Precipitation.		
	Station, reduced to mean of 24 hours.	Sea-level reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Inches.	*Inches.*	*Inches.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	*Inches.*	*Inches.*	*Inches.*
St. Johns, N. F	29.87	30.01	+0.10	49.0	−2.6	55.9	42.1	87	34	2.55	−0.05	
Sydney, C. B. I	29.99	30.03	+ .08	52.6	−2.8	62.0	43.3	74	32	3.98	+0.75	
Halifax, N. S	29.92	30.02	+ .07	55.7	−2.0	65.0	46.4	79	32	4.58	+0.82	
Yarmouth, N. S	29.96	30.03	+ .08	55.8	+0.8	64.4	47.1	75	35	1.60	−1.16	
Charlottetown, P. E. I	29.98	30.02	+ .10	55.0	−2.4	63.0	46.9	75	37	2.16	−0.51	
Chatham, N. B	30.01	30.03	+ .14	58.9	−1.1	69.5	48.3	86	35	5.39	+1.93	
Father Point, Que	29.97	29.99	+ .12	53.7	+0.7	62.4	45.0	83	34	2.08	−0.90	
Quebec, Que	29.67	29.99	+ .07	62.4	+1.2	73.4	51.5	85	43	2.36	−1.29	
Montreal, Que	29.78	29.98	+ .04	65.3	+0.4	74.7	56.0	84	48	2.59	−0.94	
Stonecliffe, Ont	29.39	29.90	+ .05	60.9	−0.7	74.6	47.2	90	37	2.04	−1.12	
Ottawa, Ont	29.73	30.05	+ .11	63.6	−1.7	74.3	52.8	85	47	3.53	+0.61	
Kingston, Ont	29.70	30.01	+ .04	62.0	−1.4	71.2	52.7	81	44	2.72	+0.29	
Toronto, Ont	29.60	29.97	.00	62.2	−1.2	73.1	51.3	82	43	1.33	−1.47	
White River, Ont	28.66	29.97	+ .03	51.7	−7.0	66.9	36.5	81	24	2.76	+0.54	
Port Stanley, Ont	29.37	30.01	+ .04	60.6	−3.2	70.5	50.6	80	37	4.35	+1.62	
Southampton, Ont	29.29			57.8	−2.6	67.7	47.8	86	36	3.84	+1.49	
Parry Sound, Ont	29.31	29.99	+ .03	60.6	−0.9	73.3	47.8	87	37	2.85	+0.43	
Port Arthur, Ont	29.27	29.98	+ .04	53.6	−2.8	63.5	43.8	74	32	4.69	+1.96	
Winnipeg, Man	29.10	29.92	+ .03	57.0	−5.2	68.5	45.4	86	30	2.56	−0.73	T.
Minnedosa, Man	28.12	29.92	+ .03	54.3	−5.3	65.8	42.8	84	30	3.86	+0.86	0.2
Qu'Appelle, Sask	27.65	29.88	+ .01	53.9	−6.0	65.0	42.7	78	26	2.66	−0.76	
Medicine Hat, Alberta	27.63	29.88	+ .03	60.0	−2.0	71.1	48.8	85	40	4.67	+1.01	
Swift Current, Sask	27.34	29.88	+ .01	55.8	−0.2	66.4	44.1	81	31	2.72	+0.05	
Calgary, Alberta	26.36	29.85	+ .01	54.1	−1.9	65.6	42.6	78	35	4.02	+1.57	
Banff, Alberta	25.40	29.96	+ .12	50.2	−1.3	62.2	38.1	76	31	6.05	+2.72	
Edmonton, Alberta	27.66	29.93	+ .09	54.2	−2.7	64.7	43.6	74	32	5.46	+2.60	
Prince Albert, Sask	28.32	29.87	.00	53.9	−3.8	63.5	44.4	77	29	2.88	+0.37	
Battleford, Sask	28.19	29.92	+ .06	57.1	−2.4	69.5	44.7	80	30	1.39	−1.92	
Kamloops, B. C	28.77	30.04	+ .17	63.3	−0.5	75.0	51.5	88	44	2.49	+1.07	
Victoria, B. C	29.87	30.12	+ .11	57.8	+1.5	65.1	50.5	82	43	0.61	−0.59	
Barkerville, B. C	25.68	29.95	+ .08	49.5	−1.2	61.1	37.9	72	30	5.27	+1.79	9.0
Hamilton, Bermuda	29.90	30.06	− .06	73.6	−1.4	79.3	67.8	84	65	10.98	+5.08	

Chart I. Hydrographs of Several Principal Rivers, June, 1915.

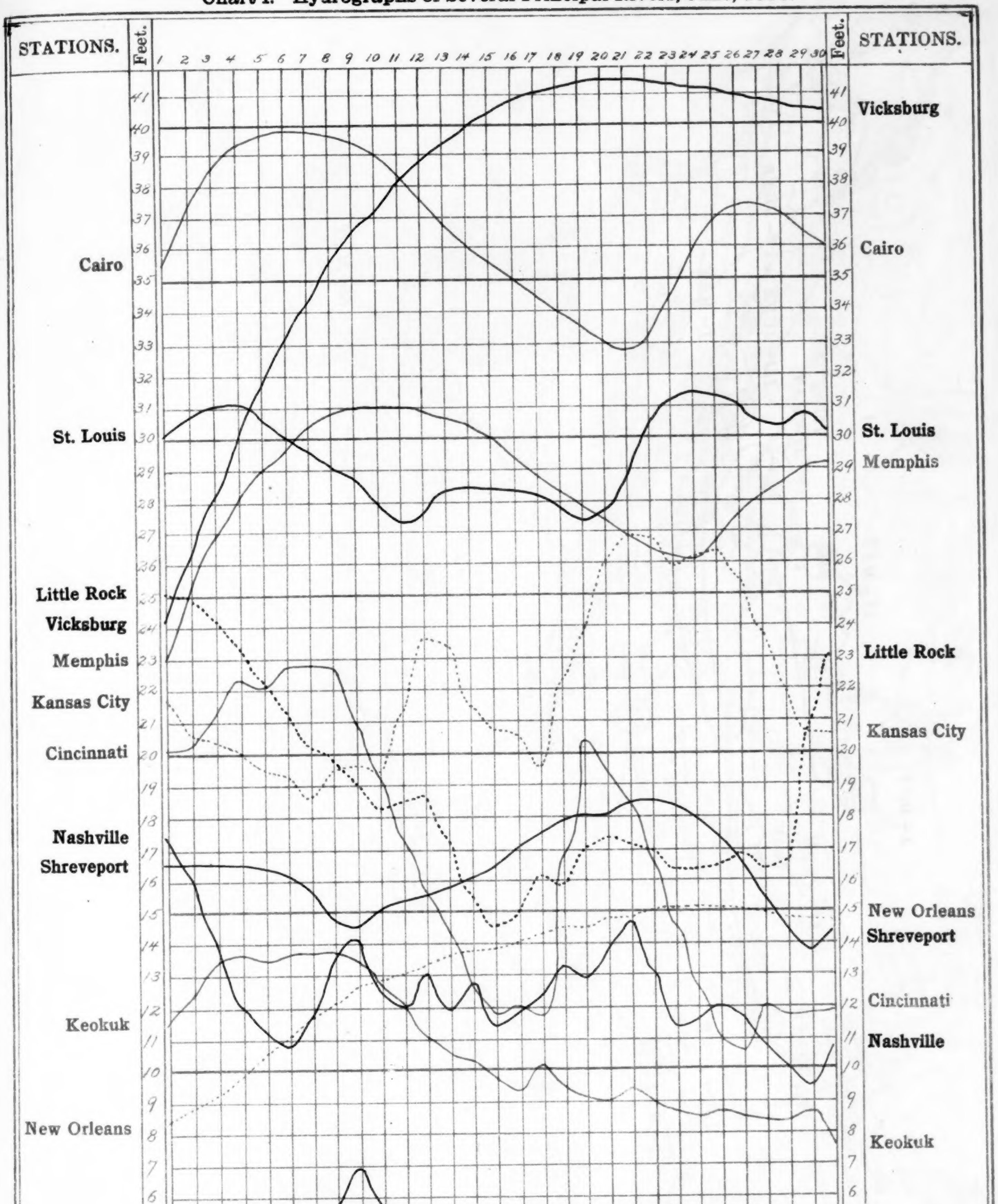

Chart Ia. Paths of Highs and Lows in May and June, 1915, Associated with Heavy Precipitation in the Missouri Valley.

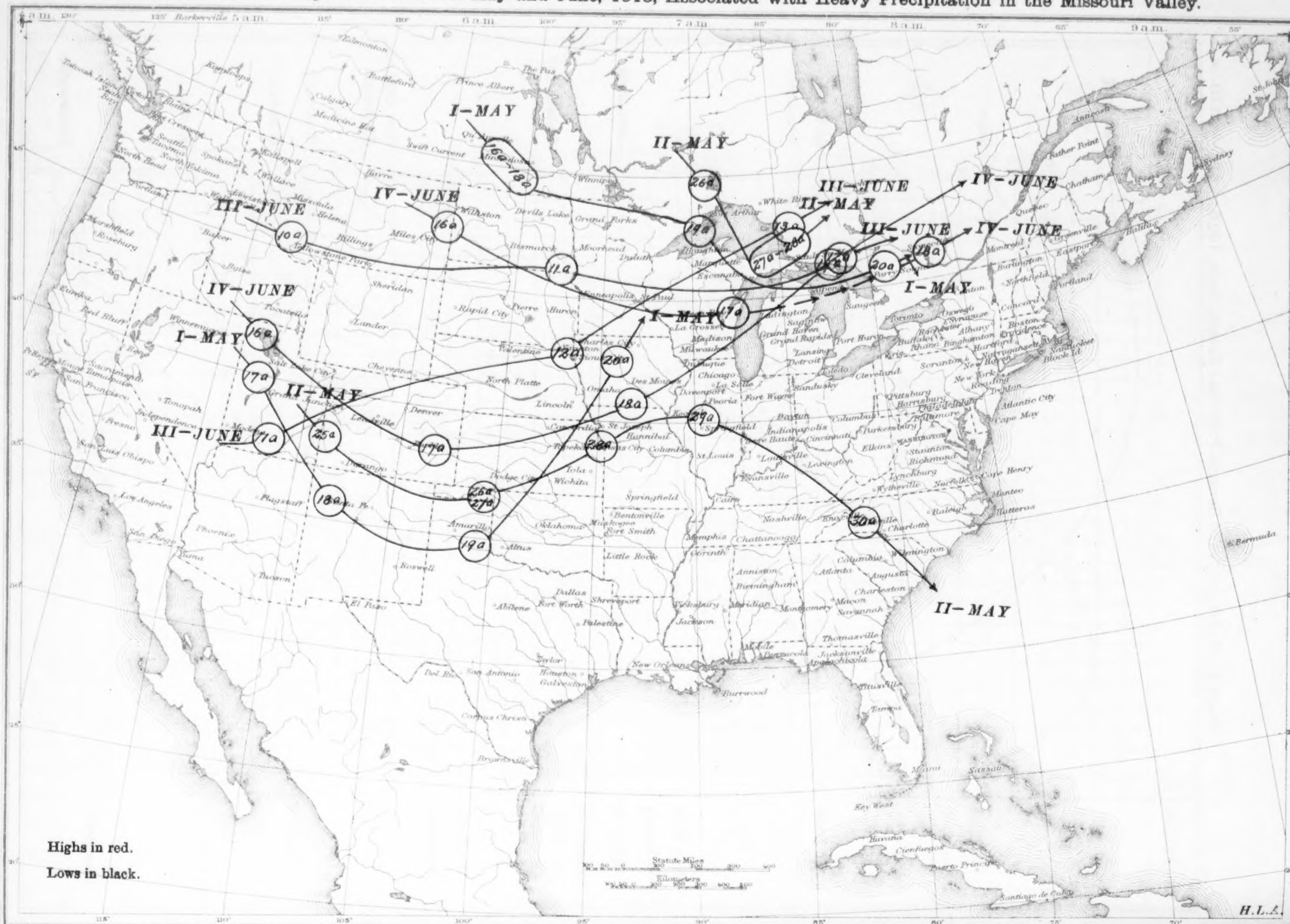

Chart II. Tracks of Centers of High Areas, June, 1915.

Chart II. Tracks of Centers of High Areas, June, 1915.
(Plotted by R. H. Weightman.)

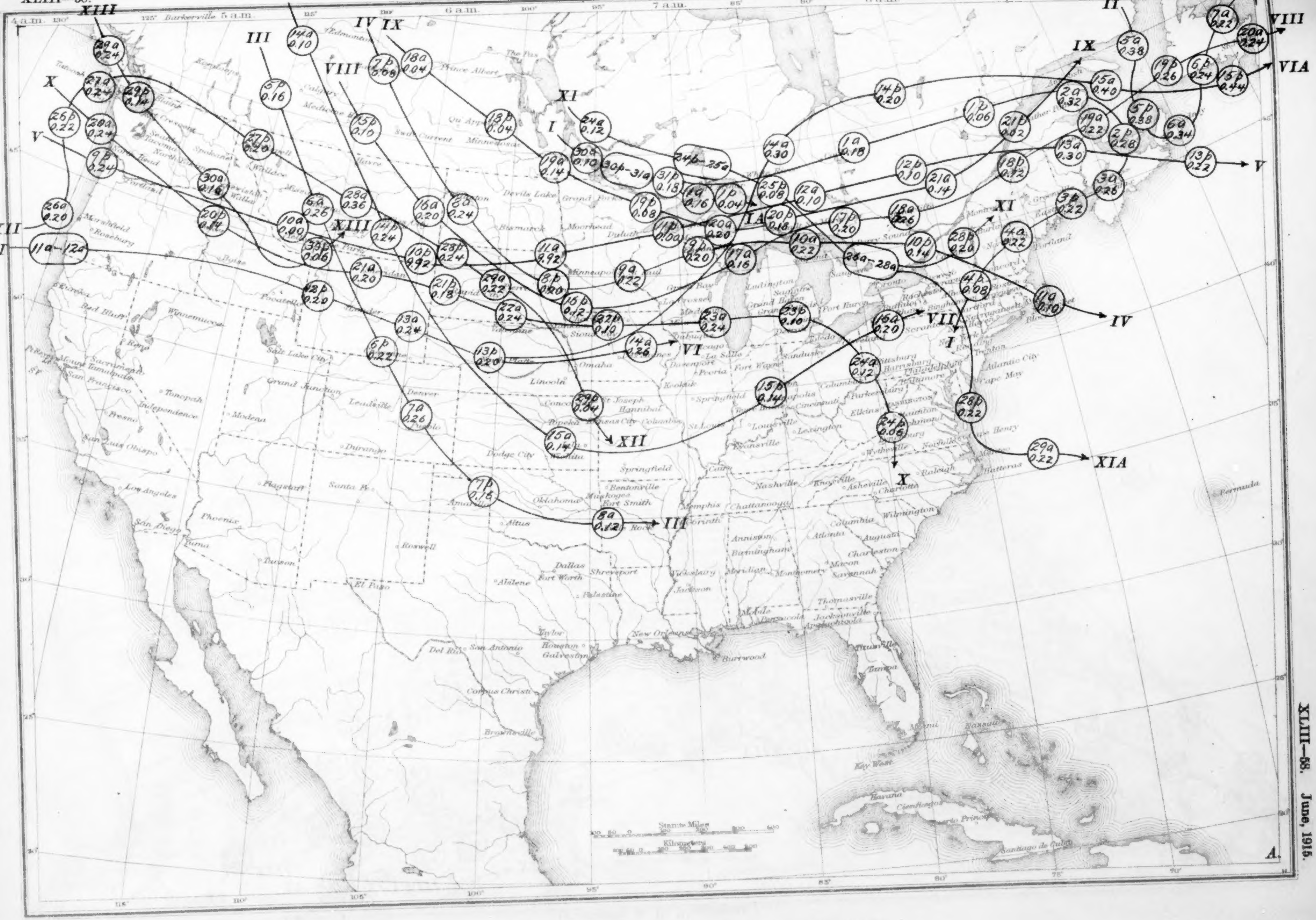

Chart III. Tracks of Centers of Low Areas, June, 1915.

(Plotted by R. H. Weightman.)

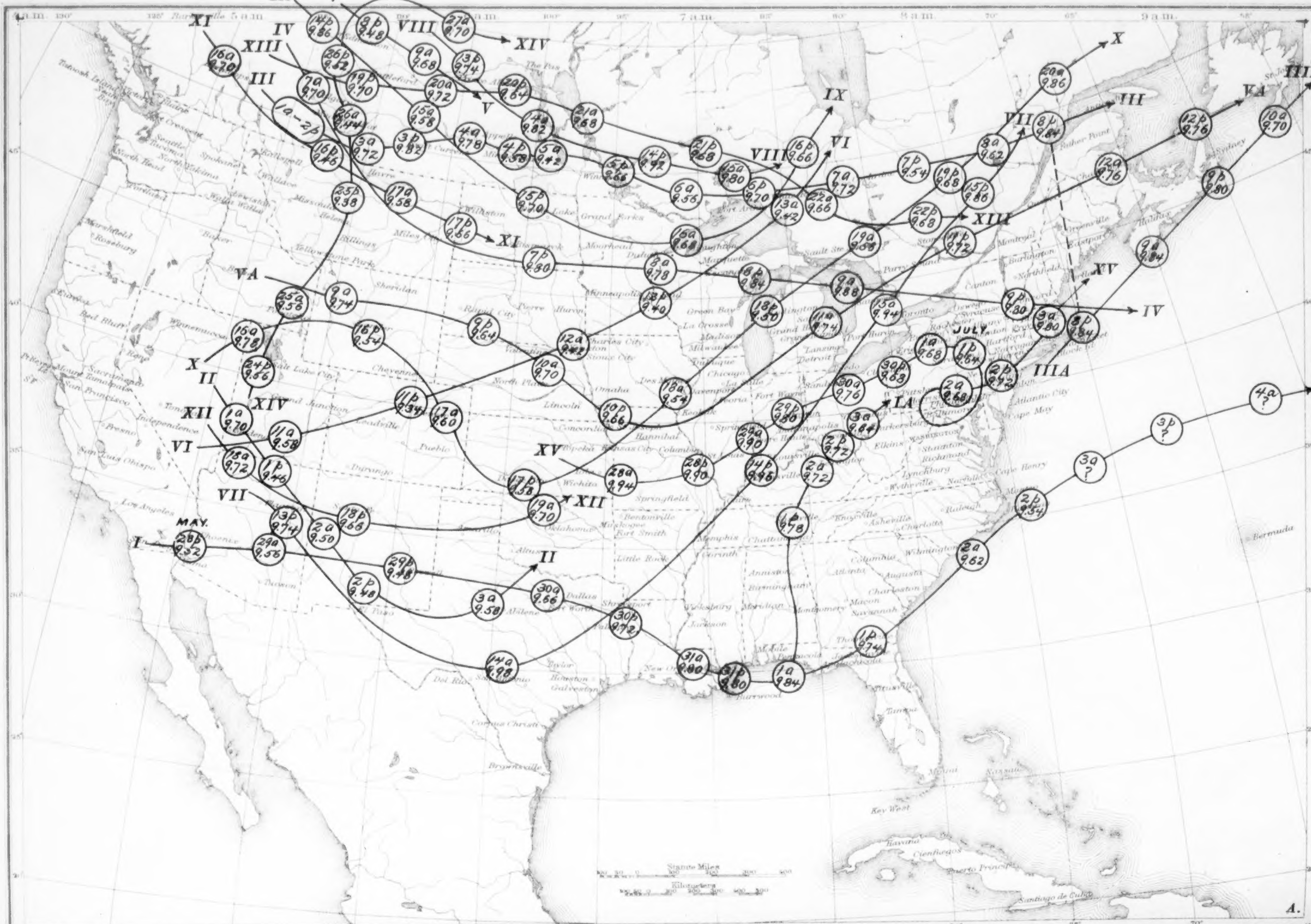

Chart IV. Departure (°F.) of the Mean Temperature from the Normal, June, 1915.

Chart V. Total Precipitation, Inches, June, 1915.

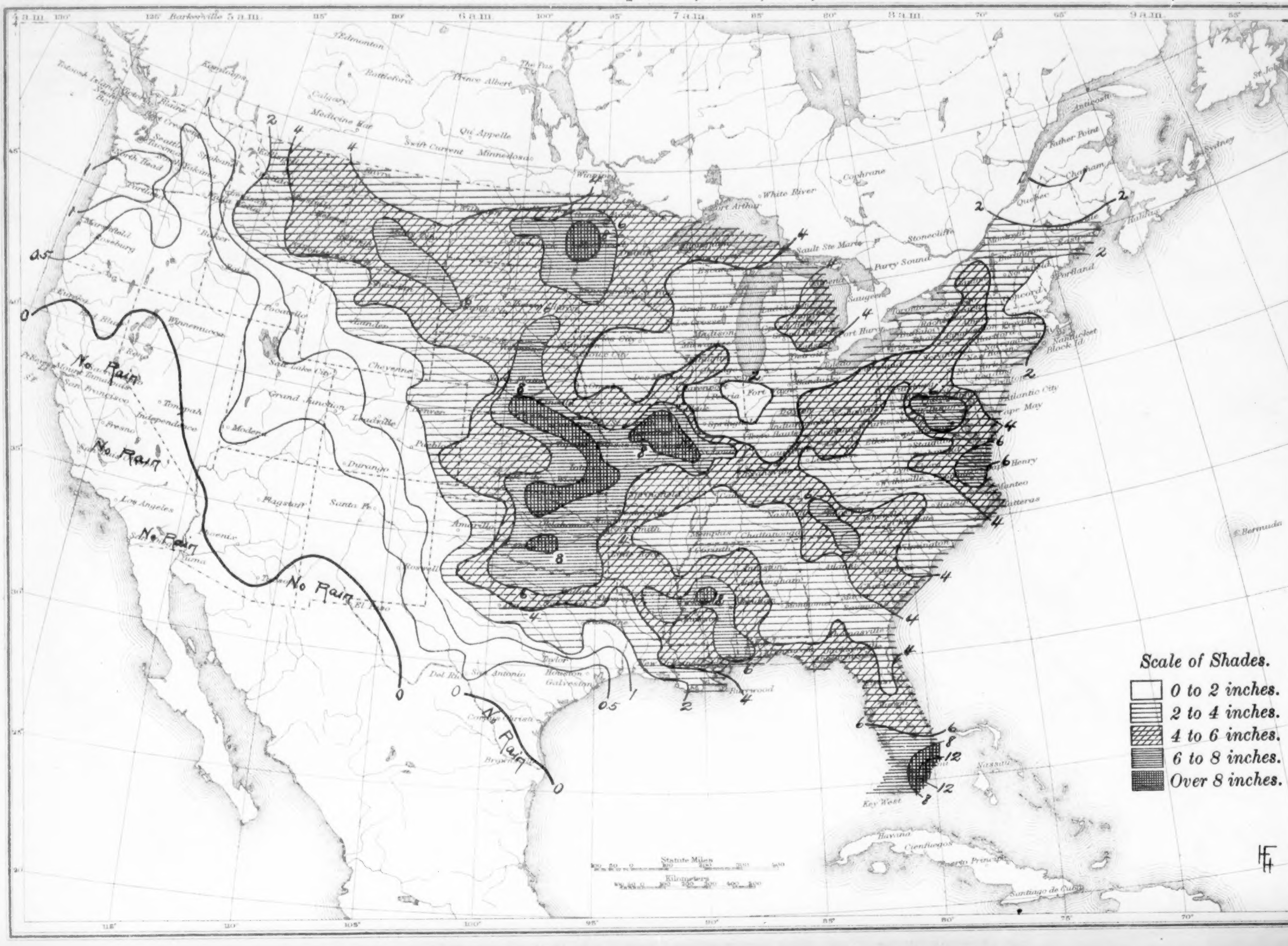

Chart VI. Percentage of Clear Sky between Sunrise and Sunset, June, 1915.

Chart VII. Isobars and Isotherms at Sea Level; Prevailing Winds, June, 1915.